THE PRACTICAL ZONE SYSTEM

FOR FILM AND DIGITAL PHOTOGRAPHY

CLASSIC TOOL, UNIVERSAL APPLICATIONS

SIXTH EDITION

A **Focal Press** Book

CHRIS JOHNSON

ROUTLEDGE

THE PRACTICAL

Zone System

for Film *and* Digital Photography

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Preface to the Sixth Edition

Less than a week ago, as I write these words, I received word that the Impossible Project had begun the full-scale revival of a photographic tradition that most of us were sure had been lost forever. It's very interesting to consider what it means that Polaroid films and cameras are available again given how dominant digital processes have become in the world of photography. Ansel Adams was one of the earliest and strongest proponents of Polaroid instant processes so I know he would be pleased.

One implication of this development is that photography as a medium remains strongly diverse with professional fine art and commercial practitioners who need specialized tools and methods to do their work.

This also explains why the Zone System remains relevant in this overwhelmingly digital photographic world.

On the one hand there are many photographers who are working with film and chemistry because there are qualities about analog processes that they truly love. It's one thing for older photographers to hold onto familiar ways of working. It's quite another to meet young photo-artists who are choosing to shoot film because they have discovered a process (and a culture, really) that resonates with their individual forms of self-expression. More than anything else, these artists need to understand how film and exposure work. This edition is primarily for them.

It has also become clear over the years that digital methods are no replacement for really understanding how photographic exposure can function as a powerful creative tool. This is the essence of why the Zone System remains important.

Those of us who knew and worked with Ansel Adams know that he would most likely have been at the forefront of the digital revolution, just as he was when Polaroid materials became available. In fact, in 1980 he was quoted as saying, "I actually feel that in the next few years—it won't be very long—the electronic image is really going to be the medium in photography."

Some photographers who were reluctant to make the transition to digital methods—either because they instinctively disliked working with computers and monitors or because they love the process of darkroom printing—are now finding that it's a necessity to make the change. For them, the question is how to make this transition in a way that is most compatible with their personal creative approaches.

One of the ironies of photography's digital revolution is that many people assume that working with Adobe Photoshop and digital printers necessarily means leaving behind many of traditional photography's fundamental methods, skills, and even some of its values.

And yet, the reason all of this matters is that the beauty and quality of digital prints can be astonishing! The first digital print I saw was created by Graham Nash's company Nash Editions, and the combination of deep and rich saturated blacks on thick drawing paper made an impression on me that I will never forget.

But, inspired as I was by the quality of that image, I quickly discovered that it was produced with an Iris printer that cost more than $100,000, and even though inkjet printer prices are now far less, digital photography does require mastering a new vocabulary and new ways of working.

But, in a deeper sense, there is really nothing new in this process. In some ways, photography has become increasingly technical and complex; in others, it is much more simple and automatic than it has ever been.

It is hard to remember that there was once a time when photographers had to build their own cameras and formulate their own chemistry and papers from scratch. What always makes all of this effort and expense worthwhile is that, if we are willing to invest the time and energy to adapt to changing methodologies, we get to be photographers and participate in the magic that that entails!

And so, in the midst of all these promising but bewildering changes and choices facing contemporary photographers, what does the Zone System have to add that could be of value? And what about the Zone System's reputation for being formidable and difficult to learn?

More than anything else, an artist has to be able to master technical and formal skills so that free expression can flow freely and without distraction. For example, dreaming, our most spontaneous form of creative expression, is effortless.

What makes the Zone System almost universally practical is that it is a visual and conceptual language that allows photographers to imagine and see and manipulate photographic tools in a seamless and straightforward way.

As you will learn in forthcoming chapters, the keys to this practicality are the different ways that the concept of the "Zone" is understood within the System.

A "Zone" is, all at once, something that you can see in the world, something you can visualize in a print, something you can measure with any light meter, and something you can dial into your camera with shutter speeds and apertures. Photography suddenly becomes a flexible creative process with end results that are predictable.

Most think of the Zone System as being strictly related to film exposure and development. In fact, although this may sound grandiose, the Zone System can actually be a way of seeing the world with applications in every form of photography, including digital.

A good example of this is demonstrated in Chapter 11, "The Zone System and Studio Lighting Photography," where I explain the process of re-creating a classic tableau by Bill Brandt in a lighting studio. Unless you have a lot of experience or specialized training, the process of conceptualizing and executing complex studio lighting setups can be challenging. As you will learn, the language of the Zone System makes it possible to visualize the whole setup in terms of easy to identify "Zones," specific tonal values that you can meter for and render.

The Zone System is powerful and flexible, and many experienced photographers have developed personal working methods that are essentially variations of the Zone System, sometimes without even realizing that this is true. (Appendix V contains a number of examples of how the Zone System can be applied to a wide variety of different photographic approaches.)

Until Ansel Adams (in collaboration with Fred Archer) formulated the Zone System, a serious student had only two choices: either study sensitometry at a professional school or stumble along learning how to solve problems by trial and error. The Zone System has done away with all of that. But unfortunately, over the years, the Zone System has gained a reputation for being highly technical and a complex waste of time. Happily, this isn't true.

The fact is that the Zone System can be very easy to learn and practical to use if it's approached in the proper way.

After teaching hundreds of students, I can confidently say that if you have learned how to develop a roll of film or edit an image in Photoshop, you can learn to master the Zone System. To make this fact instantly clear to my students, I've made a routine of asking them who is most confused about photographic technique. I then take this person outside, and when we come back after no more than 2 minutes, that person is able to demonstrate, using a Phase One digital back, a mastery of exposure that never fails to amaze the rest of the class.

I'm able to do this by using an extreme form of the approach used in this book: I simply show how to use my modified spot meter without bothering to explain why it works the way it does.

An analogy could be made to learning how to drive a car. It could be argued that one should begin driving lessons by carefully explaining in detail how internal combustion engines work, what gear ratios mean to the transmission of mechanical energy from the pistons to the wheels, and so on. This is roughly equivalent to teaching students approaching the Zone System about logarithms, characteristic curves, and sensitometry.

The problem with this approach is that after you have finished explaining these subjects in detail, what have the students really learned? Have you really completely explained the processes involved? Are there not always ever more subtle and deeper questions of engineering and physics that you have glossed over because you have decided that they are not important?

There will always be people who want to know more, and at some point all educators need to draw a line at what they think students need to know before sending them off to experiment on their own.

My approach to writing this book has been to avoid trying to explain all the science behind the Zone System. Instead, I teach all of its basic principles and the logic of how it applies to real life.

I realize that some will find this approach not rigorous enough, but after my years of teaching the Zone System to beginning students, my experience has been that once you understand enough to begin achieving consistently good results, the confidence you will gain from that accomplishment will carry you through the learning process to the level of skill you need for your work.

There are a number of excellent, more detailed technical books on the Zone System that should be read by those who favor a scientific approach to their work, and some of them are listed in Appendix W under the section titled "Technical Resource Books."

The second question this book addresses is: What information do you really need to be able to apply the Zone System to your own photographic problems?

The answers to this question are contained in Chapter 9, "Zone System Testing: Method 2." Here, you will find the results of tests that a good friend and I conducted on many different films in a variety of different developers (see Appendix I for a description of our testing method). These tests, which made use of all the major products, were conducted under actual shooting conditions. We then spent time field-testing these results in a working photo lab and with my students at the California College of the Arts to assure their accuracy. Appendices H and I contain comprehensive descriptions of the characteristics and uses of all these products.

My hope is that by updating and expanding this information, and adding discussion on subjects such as digital photography and studio lighting, I ensure this book remains a truly practical guide to the Zone System.

As you begin this text, keep in mind that the Zone System is not intended to be an end in itself, any more than is the study of medicine. Learning any new technique necessarily involves an ordering and restructuring of the way that you perceive the world. The beauty and the real value of the Zone System unfolds in the practice of actually using it to create meaningful images. The problem is trying to create with no system at all.

As you begin to use the Zone System, you will find yourself modifying and adapting it to best serve your own needs. As this happens, the Zone System will become less formal and more a natural part of your creative life.

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This book could never have been completed without the advice, generosity, and support of my friends and students and Marti Schoen, who created the drawings for the first edition. I would like especially to thank Steve Dunham for helping to formulate the basic approach presented here.

I am deeply grateful to the following people for their important contributions: Christine Alicino, Sandi Anderson, Chris Boehnke, Tim Bruno, Tyrone Burns, Laura Ciapponi, Dea Cioflica, Susan Ciriclio, Judy Dater, Iris C. Davis, Eddie Donoghue, LaShaune Fitch, Sean Grady, Kevin E. Graham of Ilford's Imaging Products Division, Charlene Harrington, Sharon Madden-Harkness, Radhika Hersey, Don Hilliker of Kodak's Professional Imaging Division, Connal Hughes of Cabbage Design Company, Jim Jordan, Malcom Kwan, Robert Bruce Langham III, Jingyuan Li, Amanda McCarthy, Amy Evans McClure, Justin McFarr, Selene Miller, Julio Mitchel, Margaretta Mitchell and Frederick Mitchell, June Moss, Anne Nadler, Fred Rohe, Julia Rowe, Frank Schultz, Jean Schultz, Bob Semenak of Robyn Color Lab, Ben Shaykin, Raphael Shevelev, Suzanne Taetzsch, Will Van Overbeek, Laura Walton, Anne Walzer, Reggie Webb, Ben Yerger, Richard Zakia, and Lagrima de la Luna Zegarra.

I would also like to again thank Arlyn Powell and David Guenette for their patience and support in the publication of this book's first edition.

And, of course, none of this would have been possible without the genius of Ansel Adams, who was not only a master artist, but also the conceptual father of the Zone System.

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Why and How to Read this Book

As you can imagine, one of the major challenges in writing a new edition of this book was how to accommodate the needs of photographers who are in the midst of the profound transition the world of photography is experiencing. Some photographers are interested in the Zone System because they fully intend to continue working with film and developers. Others may have learned that the Zone System is useful but are not sure how it applies to the digital world. And then there may be those who are committed photographers but have never shot or developed a roll of film and never intend to.

Ironically, many of those who are inclined to follow a "pure" approach to either digital or film photography eventually discover that the hybrid nature of the medium is hard to avoid. Film photographers who want publish their work need to at least understand the essentials of scanning.

But why would a purely digital photographer need to learn about film and the Zone System? The answer is that digital photographers who are looking for the highest possible quality for their work—let's say they are trying to make huge digital prints with no loss of image quality—will discover that, unless they own or can rent a $44,000 high-end digital scanning back like the Phase One IQ260, the way to get the greatest number of high-quality pixels is still to shoot a film grain film and scan the result with a

As long as I can earn enough to pay my taxes I'll be happy. I'm not a professional photographer you know, I'm an amateur. "Amateur" is the French word for lover.

—Imogen Cunningham

Hasselblad Flextight X5 scanner. But, of course, unless the film is properly exposed and developed, the results will be very disappointing.

The exciting thing about the Zone System is that it has a lot to offer photographers in all of these categories. This is because, as mentioned in the Preface, the real power of the Zone System lies in the fact that it is a comprehensive visual language with a simple vocabulary of elements that apply to all photographic practices.

Still, the problem remains, how to draft a book that doesn't bore or waste the time and attention of photographers who have specific needs?

Below is how this book addresses these issues.

First, as with the fifth edition, this edition is written throughout with an awareness of the dual nature of the photographic world.

Second, within each chapter, I have included clear headings for sections that apply only to one approach or the other. For example, in Chapter 2 that outlines the fundamental problems that the Zone System is designed to address, there are sections titled "Working with Paper Grades" and "Working with Problem Negatives" that are primarily for film photographers only.

But finally, and this is perhaps the most important thing for readers to understand, the ultimate goal of this book is to leave every reader with a clear and comprehensive understanding of how the Zone System functions as a versatile creative tool. I joke with my students that you will know that you have fully internalized the Zone System when you find yourself asking for your toast as "Zone IV."

For this reason, although there are necessarily still sections devoted primarily to film and digital processes, I highly recommend that all serious photographers read through the book as if it were a narrative telling an important story.

Even if there are parts that are not immediately applicable to your practice, you will better understand the concepts by seeing how they apply from one area to another. Those who are familiar with Adobe Photoshop will note that many of the major image editing commands use wet darkroom tools as metaphors for how they function. "The Burning and Dodging" tools are just two examples.

If, on the other hand you are already completely familiar with the Zone System and simply want to know how it applies to your digital work, you should skip ahead to Chapter 10 "The Zone System and Digital Photography."

For those who are just beginning photography, I'd suggest that you start by reading "A Primer on Basic Photography" in Appendix G (page 264). The primer will acquaint you with most of the language of basic photography and will generally make it easier for you to understand some of the new concepts that you will learn.

One final question: How does all of this apply to the bewildering array of equipment choices available to photographers these days?

In this book what I have done is begin by outlining concepts and principles that are broad enough to include many different tools and applications. Then, rather than trying to explain how these concepts apply to every conceivable camera, film, and software choice available, what I do instead is lay out what I've learned about how to achieve fine results with the limited selection of materials and processes that I've mastered. What you'll find is that these methods inevitably apply to many other tools and platforms but in specific ways you may have to figure out for yourself. This has always been true for photography, but even more so now that things are changing so fast.

My hope is that this book will make it easy for you to achieve your goals with either film or digital photography. Photography as a creative process is challenging enough without having to struggle with technical issues. Anything we can do to gain more control over this process is worth the effort and this is what the Zone System is all about.

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chapter **one**

"Will It Come Out?"

Introduction

Before the vast popularity of digital photography, the loneliest people in the world were probably photographers in darkrooms waiting to see if their negatives turned out the way they had hoped. This is true for photographers still working with film, and an equivalent problem exists when digital photographers compare the previews they see in their cameras to the results they get when they attempt to make a fine print from the image file.

Add to this the frustration of trying to make a fine print from a bad negative, and it is easy to see why uncertainty about photographic technique can be a major stumbling block for many photographers. The anxiety that you may have lost an important image goes a long way toward explaining the proliferation of automatic cameras and, more recently, digital photography that provides instant confirmation that your image is worth saving.

An important related issue to consider is the fact that very often, the most imaginative and effective rendition of a photographic subject is not one that simply records what the photographer saw in a simple or literal way. The works of classic artists like Bill Brandt or Wynn Bullock (not related to the above-cited author as far as I know) are dramatic examples of this principle. Direct translations of the visual world are often lifeless and boring.

During a portion of a fourteen years experience as an amateur photographer, I always supposed that a good judgment, combined with experience (the latter implying the generous use of time and plates), would eventually enable me to obtain a good negative every time I exposed a plate. . . . That was my greatest mistake.

. . . From "My Greatest Mistake"

—by William Bullock
Bulb and Button Magazine, September 1900

Smartphone photography is an exciting genre unto itself, but for many kinds of professional or creative work, automatic point-and-shoot cameras are too limited.

What many photographers need is a clear and direct working method that allows for creative photographic "seeing" and that produces predictable results. This is exactly what the Zone System is designed to do. When used properly, it will allow you to deal confidently with any exposure or development problem you are likely to encounter, regardless of the kind of photography you intend to do.

Anyone familiar with the work of Ansel Adams or Minor White knows how powerful a creative tool the Zone System can be. Until now, the problem has been finding a way of making the Zone System practical and efficient for photographers who would rather devote their time to being fully present in the photographic moment.

I recently came across a quote by the renowned master photographer Wynn Bullock that makes this point beautifully. Wynn is the creator of the iconic photograph on the cover of this book. Titled "Let There Be Light" it is a perfect example of what can happen when a powerful creative vision is combined with an alternative but aesthetically ideal combination of exposure and film development (refer to Appendix V, "Examples: Zone System Applications," for more details about the making of this image).

Wynn Bullock and Ansel Adams were friends and Wynn's experience with the Zone System is expressed in a statement he wrote at some point in the early 1970s: "I studied and practiced the Zone System. Finally, I thought 'What the hell. It doesn't work unless I constantly test equipment and materials. I would rather spend my time concentrating on and reacting to the world around me.'"

I completely understand Bullock's feelings and saving photographers from the drudgery of constant film and developer testing was one of my primary motivations for writing this book. The irony is that, in practice, the Zone System is remarkably easy to use. I discovered this after spending almost two years wading through the available literature and experimenting with homemade densitometers in my basement.

When I began teaching photography, I quickly discovered that if I simply taught my students what I was doing in the field instead of boring them with the complicated details of why it worked, it was as easy for them to learn the Zone System as it was for me to use it. In other words, it is not the system itself that confuses people, but rather the highly technical details some people use to explain it.

The Zone System can give you a completely new way of photographically seeing the world around you. When you begin using it, the path between what you see or can imagine in front of the camera and what you get in your prints becomes very clear and direct.

Let's consider a number of questions that beginning students usually ask at this point.

What Exactly Is the Zone System?

Basically, there are two technical problems that frustrate serious photographers. The first problem is how to give your film the proper amount of exposure (the correct aperture and shutter speed). It is very difficult to make a fine print from a negative or digital file that is seriously under- or overexposed.

Digital photographers often think that they are immune to this problem because they can instantly see a "preview" of their images. There are two problems with this approach: First, the image the camera shows you is actually more of a "postview" than anything else. The moment and the action you were photographing are gone by the time you see the image. If a different exposure would have produced a stronger photograph, it's too late at that point to make that change. Second, the image generated by the camera is a small JPEG version of the resulting digital file. You don't get to see the true uncompressed version of your photograph until you download it into your computer. This is when digital photographers sometimes discover that their image is full of digital noise in the darker areas of the subject or blown-out highlights.

So-called "averaging" methods of exposure are unreliable, and bracketing cannot assure that you correctly exposed any given frame of your roll.

The Zone System teaches you a simple way of using any reflected-light meter to achieve exactly the exposure you want every time.

The second problem is how to produce printable negatives or digital image files from scenes that have too much contrast or, in the case of film, sometimes not enough. The processing instructions provided by film and chemistry manufacturers are not adequate for dealing with the variety of lighting situations facing photographers in the real world, and Adobe Photoshop cannot solve every photographic problem.

With film, the Zone System teaches you how to control the contrast of your negatives by *systematically adjusting the amount of time you develop your film.* In essence, you will learn that film **exposure** and **development** are the only variables that you need to control to produce consistently printable negatives. For digital photographers, the Zone System can help you avoid many of the problems caused by underexposure of too much contrast in the first place.

If all the Zone System did was allow you to record a variety of photographic subjects consistently and accurately, that would be a real advantage for many photographers.

On the other hand, we would all be transformed into sophisticated automatic cameras. In fact, through a key element of the Zone System known as previsualization, the Zone System functions as a powerful creative tool that allows photographers a remarkable degree of creative flexibility and control over the photographic process.

A good analogy can be made between the Zone System and music theory. Music is a logical organization of instrumental or vocal sounds that allows coherent melodies to be created and recorded. The Zone System is a functional codification of the science of sensitometry (the study of the way light and photosensitive materials interact) into a simple and manageable working method. Just as a musician who can read music is able to play any annotated score, be it jazz or classical, photographers can use the Zone System to interpret what they see in any number of creative ways.

Why Is Photographic Technique So Important?

Definitions of art compete with each other for relevance but I think most thoughtful commentators on aesthetics would agree with John Dewey that human experience is at the heart of all creative projects. And yet, as immediate and sure as any experience is to any given individual, it is frustratingly difficult to convey the meaning or content of what we experience to someone else. Often, the stronger and more important something we experience is, the more skill and resourcefulness is required to transmit that meaning through our work. In the case of the visual meanings that photographers experience, this is why photographic techniques is so important.

The balance between structure and content in art is an important measure of mature work. Too much emphasis on one or the other will weaken the overall impact of your images. Sloppy or careless technique is distracting to the viewer, and yet overly structured photographs are often stiff and boring. The goal of students should be to master the technical aspects of the medium so that they can easily give their work the structure it needs to be effective, without that effort impeding free expression. The Zone System is specifically designed to give photographers that freedom and control.

Is the Zone System Outdated?

Camera manufacturers give the impression that taking good pictures can be simple and automatic, so the suggestion that any given camera or meter can solve all your photographic problems is designed to inspire confidence and increase sales. Under average conditions, any good automatic camera can give you adequate results. Unfortunately, camera manufacturers cannot anticipate the variety of lighting problems that even a casual photographer routinely encounters. For this reason, automatic cameras, even when used properly, produce disappointing results much of the time.

Also, as I mentioned earlier, it is impossible to design a camera that will adapt automatically to the departures from the norm that are so important to creative photography.

The essence of art is learning how to break aesthetic rules in coherent and effective ways. To depart from average results, you need to understand the nature of the problems you are likely to encounter. The Zone System will provide you with a working method that is flexible enough to deal with these problems and give you creative control over the medium.

If the Zone System Is So Important, How Were Good Photographs Taken without It?

By necessity, early photographers became masters of estimating light values and developing by inspection (see Appendix O). If there was any doubt about the exposure, they could always bracket just to be safe. Also, as will be discussed later, the photographic printing papers used by early photographers were extremely tolerant of mistakes in development. With the increase in the speed of modern photographic papers, this is no longer true.

As you will soon learn, standardized methods of exposure and development simply are not consistently reliable. Photographers need ways to adapt their techniques to suit the variety of problems they are likely to encounter. Many experienced photographers have developed personal working methods that are essentially derivatives of the Zone System adapted to their style of shooting. The advantage of learning the system from the beginning is that it will save you a great deal of time, money, and frustration.

Do I Need a Spot Meter to Use the Zone System?

No, although it must be said that spot meters are generally more accurate than wide-angle meters, and they make choosing the correct exposure surprisingly easy. For serious photographers a spot meter is well worth the investment.

Isn't the Zone System Useful Only with View Cameras?

No. With a view camera, each frame is exposed and developed individually. As you will see, this makes applying the Zone System to large-format film photography very simple. On the other hand, the principles that govern the Zone System apply as much to roll film as they do to sheet film. Compromises are often necessary when using the Zone System with 35mm cameras, but understanding the principles involved will give you all the control you need to get consistent results.

How Does the Zone System Apply to Digital Photography?

Correct exposure and contrast control are just as important to digital photographers as they are to those shooting film. The advantage of understanding the Zone System is that it provides a flexible and consistent method for visualizing and applying effective techniques to your work.

Chapter 10, "The Zone System and Digital Photography," provides detailed explanations for how to use the Zone System with digital cameras.

Can the Zone System Be Used with Smartphone Cameras?

Not in any direct and simple way. The Zone System is an applied method of creative exposure and film development and using it effectively requires being able to manually control the exposure you use to take a given image.

At first glance it might appear that smartphone cameras are completely automatic but serious smartphone photographers will readily discover that, for example, when you touch and hold on the screen image of an iPhone camera running IOS 8 or above, you can drag the exposure up to make the image lighter, or down to make it darker. This is an application of one of the key

principles of the Zone System: You are making a decision of how you might modify the meter's recommended exposure based upon an aesthetic preference.

The ubiquity of smartphone cameras is probably the most revolutionary aspect of contemporary photography. It could be argued that this amounts to a genre unto itself.

[**note**] See my portrait of Tyrone Burns in Appendix V, "Examples: Zone System Applications," for an example of how you can use a smartphone to augment photographic reality.

Can I Use a Smartphone Light Meter Application with the Zone System?

Yes. Light meter apps have become increasingly popular as substitutes for handheld light meters that are far more expensive. As of this writing, none of these applications are specifically designed for use with the Zone System and they suffer from many of the same limitations, as do wide-angled light meters. On the other hand, once you understand the principles that govern the operations of all light meters, these apps can be very handy tools for photographers looking for alternatives to built-in camera light meters.

This subject will be covered in more detail in Chapter 5, "Exposure," but for now let me suggest that serious photographers looking for accurate and reliable results should invest in a professional spot meter and only use your smartphone light meter app when nothing else is available.

How Does the Zone System Apply to the Use of an Electronic Flash?

The Zone System is primarily designed as an aid to previsualizing, measuring, and compensating for the unpredictable contrast of natural lighting situations. With typical on-camera electronic flash units, you are providing a known quantity of light to your subject, essentially eliminating the need for routine exposure calculations and contrast measurement. (For a more detailed description on the use of electronic flash, see Chapter 7, page 75.)

[**note**] With modern electronic flash units, the exposure is determined by a thyristor circuit that controls the output of the flash head. Dedicated flash units automatically adjust both the f/stop and shutter speed of the camera.

Can the Zone System be Used with Color Film?

Digital technology has had a disproportionate impact on color photography, but regarding the remaining color films, the best answer to this question is yes and no. Three interlocking elements make the Zone System work:

1. The Zone System enables photographers to visualize their subjects as finished photographic prints. Essentially, this means knowing what results you are working toward before you begin shooting. This is a valuable skill for all photographers to learn regardless of the kind of film they shoot.
2. The Zone System teaches you how to choose the correct exposure for any given shooting situation. This is especially important for color photographers because color-transparency films are notoriously intolerant of under- or overexposure. Color negatives will tolerate a small amount of overexposure but no underexposure.
3. Photographers using the Zone System learn how to measure the range of contrast of their subjects and then how to select the appropriate development time to produce printable negatives. Being able to measure subject contrast accurately is especially important for color photographers because color films (in particular color-transparency films) are more limited in the range of contrast they can register than are black-and-white films.

Because color films must be developed within narrow predetermined limits of time, the ability to visualize, measure contrast, and choose accurate exposures is crucial for working with color materials. (For more information on color films and the Zone System, see Chapter 7, page 75.)

chapter **two**

Print Quality, Negative Contrast, and Dynamic Range

Let's begin by defining a few important terms. Throughout this book you will find that the word **contrast** has different meanings depending on whether I am referring to the contrast of the *subject* you are photographing or the *negative* or *digital file* that you will use to make the print. In general, the word "contrast" refers to the relative difference between dark and light areas of the subject or negative or in your digital image.

Subject contrast refers to the difference between the amounts of light reflected by the darker, or "shadow," areas of the scene and the lighter, or "highlight," areas (a dark door as opposed to a white wall, for example).

[**note**] In the Zone System, the words "shadow" and "highlight" are often used as general terms to describe any darker or lighter areas of the scene. Areas of the scene that reflect more or less light are also called "values." Thus, a white wall is said to be a "highlight value," and a dark wall could be called a "shadow value." In the digital realm we use the term "tonal levels" when referring to lighter or darker tones in the subject or image file. These terms will become more familiar as we go along.

Negative contrast refers to the relative difference between the more transparent areas of the negative and those that are more opaque. Because photographic negatives are actually coated with extremely thin layers of silver, they are said to have *shadow densities* and *highlight densities.**

---

* *These densities can be measured with an instrument called a "densitometer."*

The shadow densities are more transparent and correspond to the darker parts of the print.

The highlight densities are more dense in the negative and appear as the lighter areas of the print. If any of this is unclear, refer to the section "Photographic Emulsions" in Appendix G (page 264) before going on.

Dynamic range is the term used in digital photography when referring to the difference between the darkest and lightest tonal values or levels in an image. You can see an image's dynamic range as bright and dark tones in your camera preview or monitor, and graphically illustrated as histograms in some of Adobe Photoshop's image editing tools. (See Chapter 10, "The Zone System and Digital Photography," for illustrations of these tools.)

Subject Contrast and Photographic Papers: A Bit of History

It is easy to visualize how dramatically the contrast of photographic subjects can vary from one situation to another. Imagine the difference between photographing a dark tree surrounded by brightly lit snow on one day and then shooting a portrait of a blond woman wearing a light dress on a beach when it's cloudy. One scene would be extremely contrasty and the other gray and flat.

The relative contrast of a given scene depends on how light or dark the objects in the picture are and on how much light is falling on them. Learning how to adapt your shooting and film-developing methods to suit a variety of different lighting situations is essential because modern photographic films and papers produce unsatisfactory results when the contrast of the scene is either too great or too flat. Similar problems apply to digital shooting, as you will soon see.

It used to be that photographic papers were much more forgiving of negatives with excessive contrast. It's fascinating to look at old glass plate negatives and notice how amazingly dense and contrasty they could be. The reason is that legacy photographic papers were formulated with emulsions that were much less sensitive to light when compared to contemporary papers. It wasn't unusual for exposures to be many minutes under bright sunlight. This, of course, meant that the images couldn't be enlarged, so the large plate negatives were instead contact printed in glass frames. The trade-off was that, in exchange for the process being slow, photographers were able to beautifully print negatives that had an amazingly wide range of contrasts.

Modern photographic papers are very different. To allow paper emulsions to record short exposures under the artificial lights of enlargers, contemporary papers can now print negatives with only a relatively narrow range of contrasts.

The Photographic Procrustean Beds

In ancient Greece there was a myth about a diabolical innkeeper named Procrustes who offered passing strangers an invitation to spend the night on his special iron bed which he claimed would magically fit all guests. What he didn't reveal was that to enforce his "one size fits all" policy, he would either stretch unsuspecting short visitors on a rack until they fit his bed or cut off lengths of their legs if they happened to be too tall.

Historic photographic papers could generously accommodate a wide range of negative contrasts, but modern papers are distinctly "procrustean," because photographers now have to either expand or compress the contrast of their negatives so that they print well on the paper of their choice.

In the digital world, this very same problem is described in terms that are ironically also very procrustean. Under- or overexposed high-contrast digital image files are said to have highlight and shadow tonal levels that are "clipped," meaning that they are literally cut off by the editing software and are lost forever if you try to print them.

Working with Paper Grades

Every beginning photographer has attempted to make a beautiful print from a negative that has more or less than average contrast. Typically, you find yourself wasting many sheets of paper as you switch to higher contrast papers or filters to compensate for negatives that print too gray; or lower grades for negatives that are too contrasty. Either way, the results are usually disappointing. Some photographers even assume that this is what paper grades are essentially designed for.

A better procedure would be to understand the tonal separation qualities of each grade of paper and choose one that best suits the aesthetic qualities of your work. For example, some photographers like Imogen Cunningham prefer the softer tonal gradations of low-contrast papers. Others, like W. Eugene Smith, prefer the harder, more dramatic tonal transitions of higher contrast papers.

Ideally, what you would do is choose a grade of paper that best suits your work and establish that as your standard. You may, for example, decide for aesthetic reasons that from now on grade or multicontrast filter #3 will be your normal grade of paper. With this established, your goal would be to learn how to make "perfect negatives"; in other words, ones whose contrasts would allow you to easily print them on your grade 3 regardless of how contrasty or flat the original scene happened to be.

If the contrast of photographic subjects never changed, as in a studio where the lighting can be controlled, it would be easy to adopt a standard shooting and processing method that would give you good results every time. Because the contrast of scenes in the real world can differ greatly, it is necessary to learn first how to measure subject contrast and then how to compensate for it.

Although there are no films or chemical developers in digital photography, the exposure and contrast problems discussed and illustrated in the following section are very important for digital photographers to understand. Unless you use certain limited techniques that are discussed in Chapter 10, there is no way to recover highlight detail that has been obliterated because of excessive contrast in your subject and overexposure. Even if you never intend to work with film, I suggest that you carefully read through this and the following sections so that the Zone System is conceptually clear to you. We will be applying many of these concepts to the digital world, as you will see in forthcoming chapters. Along the way in this text, I will make reference to specific issues that apply to digital photography.

Working with Problem Negatives

Let's consider the four basic problems that photographers encounter when trying to make a good print from a negative that has been improperly **exposed** and **developed.**

As you will see, these four problems fall into two categories: solvable problems and those that are fatal to achieving fine prints.

THE SOLVABLE PROBLEMS

Overexposure and **underdevelopment** are serious problems that are more or less correctable in the printing process. In digital photography, this corresponds to working with an image that is too gray and flat. You'd like to avoid this, but these problems are manageable in Photoshop.

THE FATAL PROBLEMS

I realize that calling these problems fatal is a dramatic way to express this point, but the fact is that underexposure and overdevelopment are essentially lethal negative flaws that are uncorrectable. One great advantage of the Zone System is that it is specifically designed to help you avoid these two problems.

Although digital images are never "developed" in the chemical sense that film is, it is still possible to end up with an image that has problems very similar to the ones described next.

Underexposure

The simplest way to define a "good exposure" is to say that it means choosing a combination of f/stop and shutter speed that will allow the right amount of light to expose the film or digital sensor. It is important to understand that if the film or sensor receives less than this optimum amount of exposure, the negative will be too thin in the areas that correspond to the darker parts of the subject. For digital image files, underexposure results in both empty dark areas and excess noise. What makes proper exposure for either film or digital photography so crucial is that the only time your camera can record visual information in the darker shadow areas of your subject is during exposure.

Of course, underexposure will cause the entire negative to be less dense than normal, **but the lack of density in the shadow areas of the negative is critical**. When a negative receives too little exposure, it will be transparent in areas that you would ordinarily expect to print with full texture and detail (dark hair and fabric, for example). Because the necessary detail is not in the negative or file, these areas print as black, empty spaces.

Deliberate underexposure can often be used to create striking effects, but in general, these unnaturally dark areas are distracting and spoil the quality of your image. Of course, any dark area of a print can be made lighter by dodging when you make a print, **but no amount of careful printing can give a print detail that doesn't exist in the negative**.

As you will learn in the Chapter 10, underexposure is just as damaging to digital image files as it is to film. For this reason, avoiding underexposure is essential. The rule is: **A negative or digital file has to receive at least enough exposure to ensure that the important darker areas of the print appear realistically well lit and detailed.**

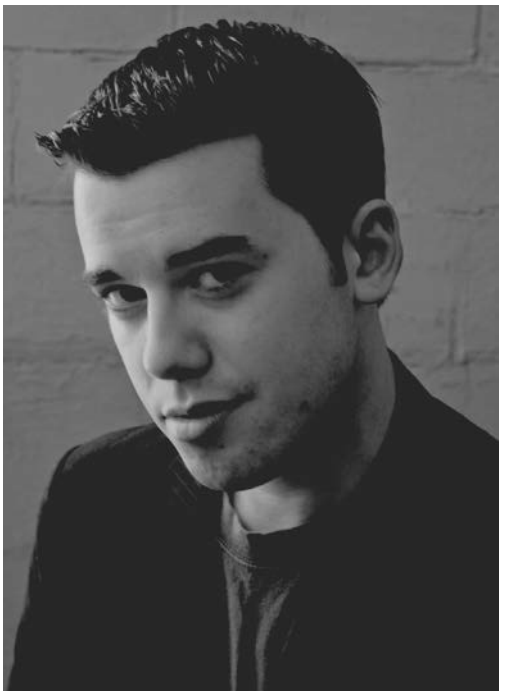


FIGURE 2.1 An example of a print made from an underexposed negative.

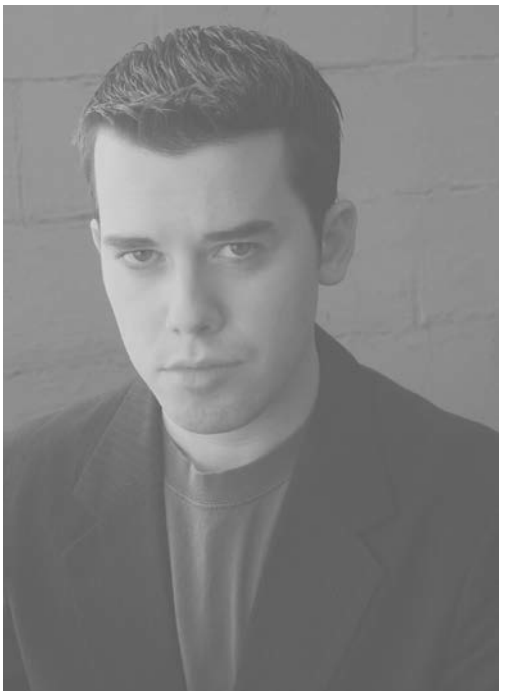


FIGURE 2.2 An example of a print made from an overexposed negative.

Overexposure

Overexposure results in negatives that are too dense in the important shadow areas of the print. Prints made from negatives or digital files that are overexposed will be gray and lack richness and depth.

Overexposed negatives are often excessively grainy with shadow areas that are too light, but it's possible to correct for this problem to some extent by giving your print more exposure under the enlarger.

Underdevelopment

Film development has its main effect on the denser or **highlight areas** of a negative. An underdeveloped negative will be too thin in these areas, and the resulting print generally will be too dark with no sense of light or brilliance.

Underdeveloped negatives usually print flat on normal grades of paper, but using a grade or filter higher than your normal one can compensate for this to some extent.

Although there is no development phase in the digital process, a low-contrast flat, digital image looks pretty much the same as a print from an underdeveloped negative.

FIGURE 2.3 An example of a print made from an underdeveloped negative.

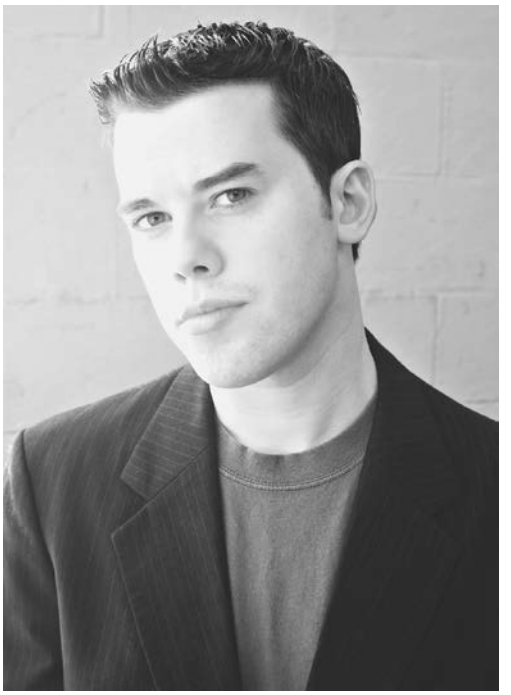


FIGURE 2.4 An example of a print made from an overdeveloped negative.

Overdevelopment

If a negative is overdeveloped, either from being developed for too long or in a developing solution that was too concentrated or too hot, or from being agitated too aggressively, the highlight areas will be too dense.

Because these densities are relatively opaque, the corresponding light areas of the print will be too white, or "blocked up." Burning in these areas when you make a print will make them darker, but it cannot replace the lost texture and detail.

Although there are no films or chemical developers in digital photography, blown-out highlight areas are just as serious a problem. As I mentioned earlier, subject areas that are too bright are clipped by the editing software, and there is no way to recover the detail that was in those areas.

A print from a properly exposed and developed negative will have rich, detailed shadow areas and brilliant, textured whites.

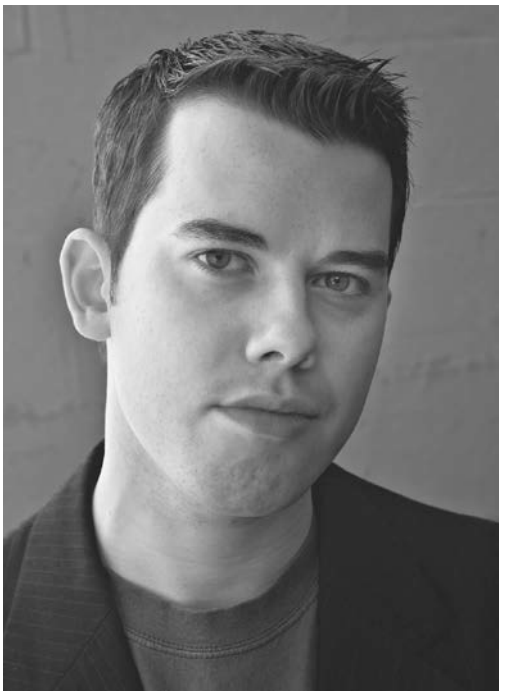


FIGURE 2.5 An example of a print made from a properly exposed and developed negative.

Summary

So far, you have learned that, although film and digital photography differ in many ways, they are both "procrustean" in that you have to adapt the way you shoot and process the negative or digital file so that important subject values fit within the parameters of the medium you've chosen.

1. If you are working with film, after you have, for aesthetic reasons, decided on your optimum, normal paper grade, learning how to control the contrast of your negatives is necessary because of the range of **subject contrasts** photographers have to cope with. If you are working with digital image files, it is also critical that you make sure that your subject's shadow and highlight values are not clipped.
2. With film, until you learn how to adapt your methods of **exposure** and **development** to suit a variety of lighting situations, you will only produce easily printable negatives when the contrast of your subject happens to be average.
   The principles of exposure also apply to shooting with digital cameras, but the methods for correcting contrast and image quality problems are different. They will be covered in Chapter 10. Understanding these principles is the first key to becoming a better photographer.
3. With film, **exposure** has its primary effect on the **shadow densities** of the negative. Film **development** primarily affects the **highlight densities**.

4. Any combination of over- or underexposure or development will result in a negative that is either too dense or too thin.
5. The two "fatal flaws" of film photography are **underexposure** and **overdevelopment** because they damage your negative quality in ways that cannot be compensated for when you make a print. Severe **underexposure** permanently obliterates necessary detail in the negative's **shadow areas**. **Overdevelopment** destroys detail in the **highlight areas** of the negative.

The corresponding problems in digital photography are **underexposure**, which results in dark and noisy **shadow areas**, and overexposure, which results in **clipped highlights** that print as **empty whites**.

Trying to make a fine print from a negative or digital file with contrast problems can be a costly and frustrating ordeal. With film, to a certain extent, graded or variable contrast papers can help, but **learning to control the contrast of the negative itself through proper exposure and development is the secret to consistently better results**.

Now that we have defined the problems, let's begin to approach the solution. Although the next chapter uses examples drawn from film photography, I highly recommend that digital photographers read through and learn the principles explained. As you will see, this will make it much easier for you to understand how the Zone System works in the digital realm.

chapter **three**

The Control of Negative Contrast

In this chapter you will begin to learn principles that provide the keys to quality and control in photographic expression. The Zone System was, of course, created in the era of film, so we will start by examining how these ideas apply to working with negatives, but behind this specific application are universal concepts. Even if you never intend to shoot a roll or sheet of film, you should learn and understand the principles here.

There is a time-honored rule that summarizes the key to consistently better negative quality: **Expose for the shadows and develop for the highlights.** This means that exposure and development can each independently control different aspects of the negative's contrast. Let's look at this process in detail.

Expose for the Shadows

Your choice of exposure for a given negative (the f/stop and shutter speed that you decide to use) should be based on the amount of detail you want in the darker areas of your finished print. If you want the shadow areas of your print to appear well lit and detailed, give the film more exposure; in other words, either use a wider aperture or a slower shutter speed. If you want the shadow areas to be darker and less detailed, give the film less exposure; use a smaller aperture or faster shutter speed.

As we discussed in Chapter 2, "Print Quality, Negative Contrast, and Dynamic Range," a mistake at this point can ruin your chances of ending up with a satisfactory image. The rule is: Exposure has its main effect on the density of the negative's relatively transparent or "shadow" areas. With digital cameras this applies to all of the darker parts of your subject: Under- or overexposing can ruin an otherwise beautiful print. After you release the shutter, the fate of the shadow densities (or darker digital tonal levels) is sealed!

Develop for the Highlights

The amount of time that you develop your film will determine the density of the negative's highlight areas and its overall contrast. Just as exposure has its main effect on the shadow areas of the negative, the film's development time will determine how white or gray the lighter areas of the print will eventually be. If you inadvertently over- or underdevelop your film, the highlight densities will be difficult or impossible to print well.

If exposure and development didn't act independently on the density of different parts of the negative, you would have no way of controlling its contrast. Knowing that exposure determines the shadow density and that development controls the highlights, you can use these two factors to your advantage.

Understanding this relationship makes it easy for a photographer with a trained eye to diagnose problem negatives. If parts of the negative that correspond to the darker areas of the subject are too thin or transparent, the negative is obviously underexposed. If the highlight areas of the negative are opaque, the negative is overdeveloped. Before you go on, try the following exercise.

UNDEREXPOSURE

1. Gather an assortment of your problem and successful prints and their negatives.
2. Look carefully at those prints that are either too dark with empty, flat, shadow areas or too gray with no black values at all.
3. On a light box (or through a window), compare the negatives from these prints with those from prints that have fully detailed, realistic shadow values. What you will see is that the shadow areas of the underexposed negatives are more transparent than the shadow areas of well-exposed negatives. More exposure would have solved the problem. You now know what an underexposed negative looks like.

OVERDEVELOPMENT

4. Look at those prints that are too contrasty with empty, glaring white areas.
5. When you compare the negatives of these prints with negatives from prints that have detailed and textured highlight areas, you will see that the overdeveloped negatives are too dense or opaque.

Overexposed or underdeveloped negatives are slightly more difficult to read, but the principle is the same.

The reason exposure and development affect the film in different ways is a function of the way film responds to different amounts of development. Figure 3.1 illustrates how this works.

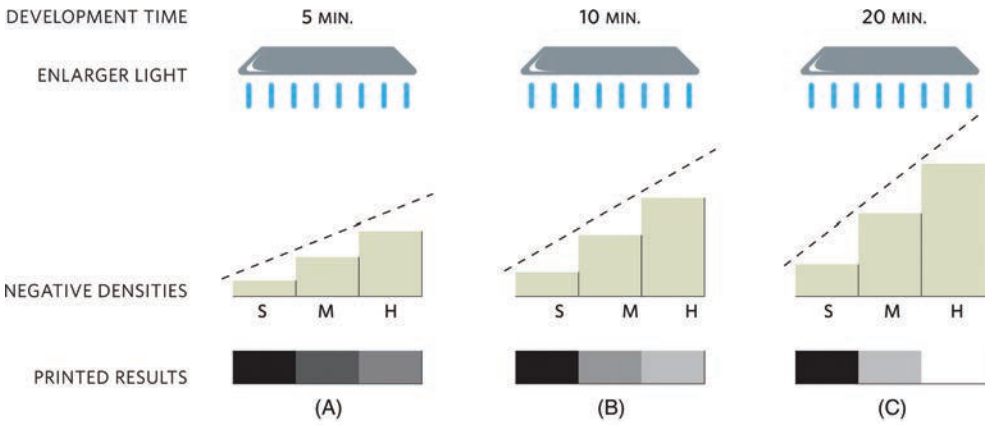


FIGURE 3.1 The effect of increased development on the shadow (S), middle (M), and highlight (H) densities of a negative.

Imagine that Figure 3.1A is a negative developed for five minutes and being viewed edge-on with greatly exaggerated shadow, middle, and highlight densities. The diagonal line illustrates the negative's contrast. The steeper the line, the more contrasty the negative.

Figure 3.1B is the same negative after being developed for 10 minutes. Figure 3.1C is the same negative after 20 minutes of development.

Notice that after 5 minutes' worth of development, all the densities have reached a given level, and the contrast is relatively flat. After 10 minutes, the density of the middle and highlight areas has increased greatly, but the shadows have hardly moved at all.

Because the middle and highlight densities increase at a much faster rate as the negative continues to develop, the overall contrast of the negative becomes much greater.

After 20 minutes of development, the highlights are much denser, but again, because the shadows have remained relatively stable, the contrast of the negative is increased.

This difference in the rate of density increase between the shadow and highlight areas is a very convenient effect. If the shadow densities increased at the same rate as the highlights, the negative would simply become more dense without any increase in its overall contrast.

The point to remember is that increasing or decreasing the negative's development time doesn't affect the shadow densities nearly as much as it affects the highlights. **This means that by varying the amount of time you develop the film, you can produce a usable negative regardless of how contrasty or flat the subject of your photograph may be.**

The general rules for controlling the contrast of negatives are as follows:

1. Your exposure should be based on the amount of detail you want to have in the darker areas of your finished print. After the exposure is made, the shadow densities are established.

FIGURE 3.2 Shadow density is determined by exposure.

2. If the contrast of your subject is very flat, you **can simply increase the negative's development time to make the highlight densities more dense** and therefore the lighter areas of the resulting print whiter.

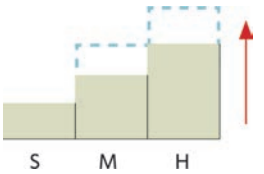


FIGURE 3.3 A longer development time increases the negative contrast of a flat subject.

3. If the subject is extremely contrasty (for example, dark foliage and bright snow in the same picture), you can compensate for this by giving the film less development.

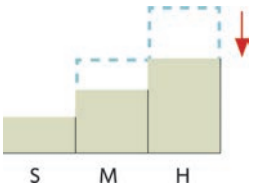


FIGURE 3.4 A shorter development time decreases the negative contrast of a contrasty subject.

In short, **expose for the shadows and develop for the highlights**.

To understand some of the implications of this rule, study the following discussion of development very carefully.

Normal Development

For every combination of film and developer, there is a certain development time that will produce negative contrast that is **equal to the contrast of the scene that you are photographing**. This is called **Normal Development**, which is symbolized by the letter **N**. If, for example, 11 minutes is the Normal Development time for your favorite film and developer, that will be true as long as you continue to use that combination and don't change any of the other variables that affect development time. These variables are dilution, temperature, and the rate of agitation.

Because, by definition, Normal Development means negative contrast will be equal to subject contrast, if the subject you are photographing has too much contrast, using Normal Development (11 minutes in this example) will result in an equally contrasty negative! If the contrast of the subject is too low, Normal Development will give you a flat negative. If, however, the contrast of the subject is average, Normal Development will result in a printable negative.

[**note**] Paper grade 2, or variable contrast filter #2, is usually considered the standard for Normal contrast negatives. You can determine the exact time for Normal Development by testing your film, as outlined in Chapter 8, "Zone System Testing: Method 1."

Figure 3.5A illustrates a negative being exposed to a subject with Normal contrast. Figure 3.5B shows that when the negative is given Normal Development, the resulting print will also have Normal contrast.

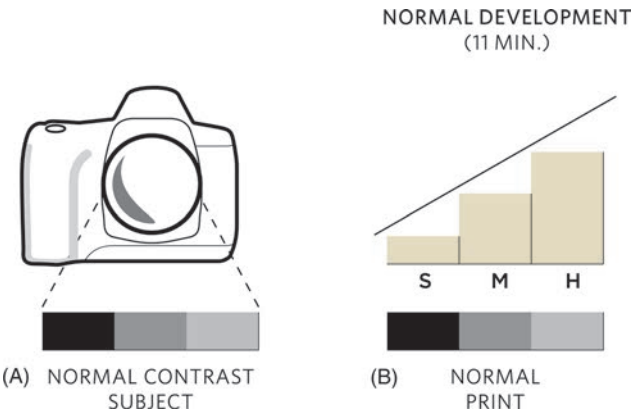


FIGURE 3.5 The effect of Normal Development on a subject with Normal contrast.

NORMAL MINUS DEVELOPMENT

If the contrast of the scene you are photographing is too great (if, for example, you are shooting in a dark room with a sunlit window in the picture), you can compensate for that problem in the following way.

First, as always, choose an exposure based on the amount of detail you want in the darker areas of the final print. **Expose for the shadows.**

Second, use a development time that is less than your established Normal Development Time to reduce the density of the negative's highlight areas.

Remember that increasing or decreasing the time that you develop your negatives will always have its greatest effect on the highlight densities. Because the shadow densities respond much less to reductions in the development time, only the middle and highlight densities of the negative will be significantly reduced. The resulting negative will have much less contrast than the original subject and thus will print as if the contrast of the subject had been within normal limits. This effect is called **Normal Minus Development**, or Contraction. The symbol for Normal Minus Development is **N–**.

Figure 3.6A shows a negative being exposed to a very contrasty subject. Figure 3.6B illustrates that Normal Development results in a negative with overly dense highlights. Figure 3.6C shows that Normal Minus Development **reduces the density of the negative's highlight areas**. The result is a print with Normal contrast and detailed highlights.

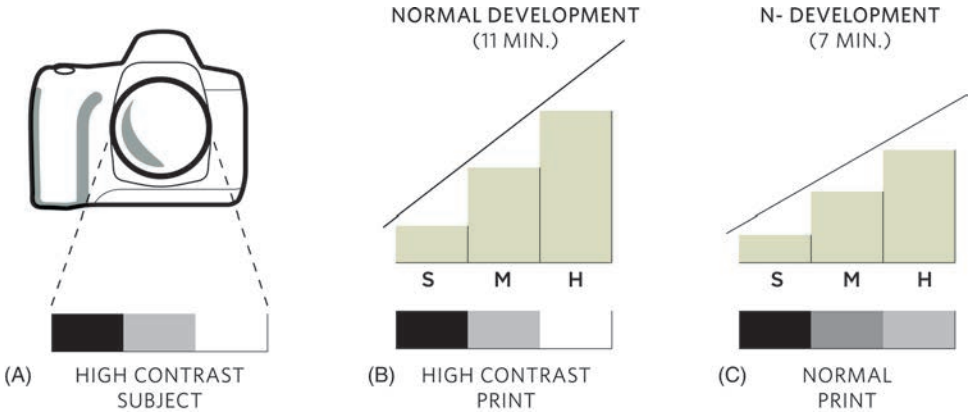


FIGURE 3.6 The effect of Normal and Normal Minus Development on an overly contrast subject.

NORMAL PLUS DEVELOPMENT

If the contrast of the subject you are photographing is too flat (for example, a dark interior or a cloudy day), you should still expose for the shadows, but in this case, you should also use a longer development time (more than Normal Development) to increase the density of the negative's highlights. This effect is called **Expansion**, or **Normal Plus Development**, symbolized by **N+**. The resulting negative will have much more contrast than the original subject and will print as if the contrast of the scene were greater than it actually was.

Figure 3.7A shows a negative exposed to a very low-contrast subject. Figure 3.7B illustrates that Normal Development results in a flat, low-contrast negative and print. Figure 3.7C shows that Normal Plus Development increases the density of the negative's highlight areas. The resulting print has Normal contrast.

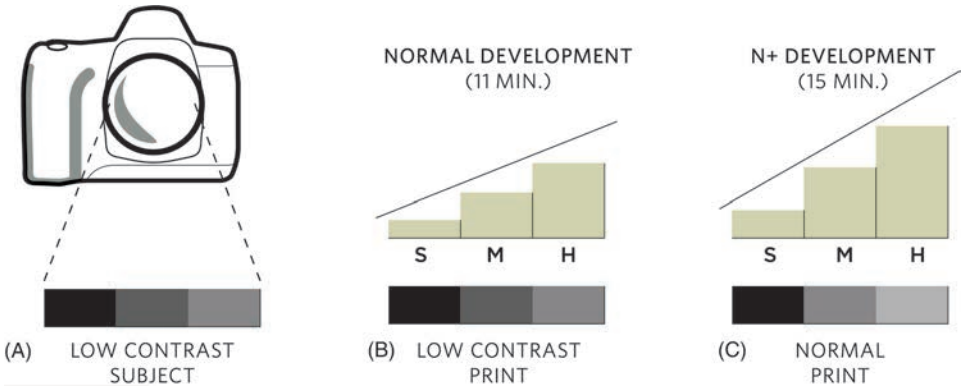


FIGURE 3.7 The effect of Normal and Normal Plus Development on a low-contrast subject.

Summary

In this chapter, you have learned two very important things about how to produce consistently printable negatives. First, the key to fine printing is controlling the contrast of the negative to compensate for variations in the contrast of the subjects you photograph.

Remember that **expose for the shadows and develop for the highlights** means choosing an exposure based on the amount of detail you want in the darker or shadow areas of your final print and then increasing your development time (to a time that is longer than Normal) if the subject has less than Normal contrast or decreasing your development time (shorter than Normal Development) if the contrast of the subject is too great.

Second, three general approaches to film development make this control possible:

1. **Normal Development (N)** is the standard development time for your favorite combination of film and developer that will always give you negative contrast **equal to the contrast of your subject**. Normal Development is the correct development time for subjects with average contrast and is determined by testing. See Chapter 8.

2. **Normal Minus Development (N–)**, or Contraction, is the reduction of your development time (shorter than Normal Development) to compensate for subjects with contrast above Normal.
3. **Normal Plus Development (N+)**, or Expansion, is a longer than Normal Development Time to compensate for low-contrast subjects.

Digital photographers should note that, in different ways, these general principles apply just as much to them as to those shooting film:

1. Exposure remains the key tool for establishing optimum quality in digital files. The difference is that digital photographers should **expose for the highlights instead of the shadows**. The specific technical reasons for this are not important at this point and are explained in Chapter 10, "The Zone System and Digital Photography."
2. Controlling the contrast of digital files is just as important for digital shooters as it is for those working with film. What's different is that digital photography provides different tools for dealing with this problem. Again, see Chapter 10 for instructions on how to do this.

Thus far, I have used the terms "high," "low," and "Normal contrast" very loosely. It is not difficult to visualize the difference in contrast between a bright, high-contrast situation and a flat, gray scene. To determine which of the preceding development procedures is appropriate, you need a way to actually measure the contrast of the scenes you wish to photograph. The visual concept that makes this possible is called the **Zone**.

As you will see in the next chapter, Zones are the key elements of a universal visual language that is a huge benefit to all photographers, regardless of how or what they are shooting.

chapter **four**

The Zone

As you have learned thus far, both film and digital photographers run into problems when they attempt to translate what they see into a final print that faithfully depicts that initial experience. If lighting and contrast conditions happen to be average, the final results may be adequate. But there are two persistent problems that routinely get in the way of successful photography.

First, if the contrast of what's being photographed is too contrasty or too flat, the results are likely to be unsatisfactory.

Or, second, if what the photographer hopes to achieve is not a literal rendering of the subject but rather an interpretation that is altered in some way, standard photographic methods offer no help.

What's needed is a tool that allows for a direct connection between what photographers either see or imagine and the fine print that is eventually made. This is exactly what the Zone System provides.

The key element of the Zone System is a "visual ruler" that allows both film and digital photographers to visualize and actually measure the difference between normal-, low-, and high-contrast subjects. This is called the Zone Scale.

FIGURE 4.1 The Zone Scale.

Ideally, the tonal values in a photograph should logically represent the light and dark values we see in the world around us. When we photograph a dark wooden wall, for example, our expectation is that the resulting print will have the tonality and detail of dark wood. The visual unit that makes this correspondence between the real and the photographed world possible is called the Zone.

A "Zone" can be defined in three simple ways:

1. **Print Values.** Each zone symbolizes a different range of dark, gray, or light tones in a finished digital or analog print. For example, Zone 0 is black, Zone V is middle gray, and Zone IX is white.
2. **Texture and Detail.** Every zone reveals a different amount of texture and detail. This allows zones to be associated with familiar objects that typically appear as certain zones. For example, in a normal black-and-white print, dark hair is usually Zone III, and snow can be printed as Zone VIII.
3. **Photographic Measurement.** Zones can easily be measured in terms of f/stops, shutter speeds, and meter numbers.

Print Values

The first definition of a zone is easy to understand if you look at the tonal values of a normal black-and-white print. To simplify these descriptions I'll be referring to the tonal values of black-and-white prints but keep in mind that these principles also apply to color photographs. In this case, the term "normal" refers to a print that is realistic and has a full range of tonal values from black to white. If you look closely, you will see that almost any photograph has within it the total range of possible print tones, from the blackest black that the paper can produce to the whitest white.

FIGURE 4.2 A full-scaled normal print (*by David Bayles*).

To begin the process of associating photographic print values with the Zone Scale, imagine the total range of tones in Figure 4.2 spread out in a smooth gradation of values that gradually lightens from pure black at one end to pure white at the other.

FIGURE 4.3 Photographic print values as a continuous gradation.

Photographs printed from film negatives are analog and effectively create the illusion of an infinite number of shades of gray. But, although digital prints are rendered from pixels, they also attempt to reproduce smooth, continuous-looking gradations.

You could, for example, divide the gradation in Figure 4.3 into any number of sections, and each one would be a little lighter than the one on its left. See Figure 4.4, for example.

FIGURE 4.4 The print value gradation divided into numerous sections.

The Zone System divides this gradation into 10 equal parts, as shown in Figure 4.5. At one end is a section that is completely black and at the other end a section that is totally white. Keep in mind that all the tonal values in each section can be related to some part of the print in Figure 4.2.

FIGURE 4.5 The print value gradation divided into 10 equal sections.

At this point, the scale is still continuous, meaning that each section is actually a "mini-gradation" that is slightly darker at one end than it is at the other. (See Figure 4.6.)

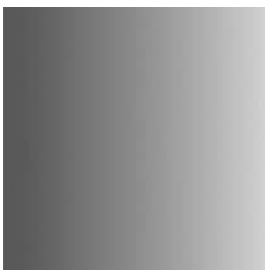


FIGURE 4.6 Zone as a mini-gradation.

To transform these sections into zones, we'll simply blend all the tonal values in each section into **one average tone that, from now on, will represent all the values in that section of the scale**.

As you will see, this is an extremely important step in this process. The fact that each zone actually represents a mini-gradation of the slightly different tonal values greatly simplifies the process of identifying zones in the real world. Instead of having to visualize the specific value of each zone, you can instead look at a given object and safely assume that its tones will fall somewhere within the range of a given zone.

The scale is now divided into 10 distinct steps, from black to white. If you assign a Roman numeral to each step, starting with 0 for the black section to IX for the white one, the steps are now officially **Zones**.

[**note**] The reason we use Roman numerals to designate Zones is to avoid confusing them with other photographic measuring systems.

FIGURE 4.7 The Zone Scale.

Here are the two key elements of this first definition of a Zone:

1. Each zone is one symbolic tone that represents the range of tonal values in its section of the Zone Scale.
2. Each zone can be related to the values in any photograph. The blackest black in a print would be Zone I, and the whitest white would be Zone IX. The clear film base of the negative is Zone 0.

By definition, the Zone Scale encompasses every possible tonal value in any photograph.

Of course, the tones in any photograph can be related directly to the values of the photographic subject. Identifying a wall *in a photograph* as Zone IV is another way of saying that the wall *itself* is visually Zone IV.

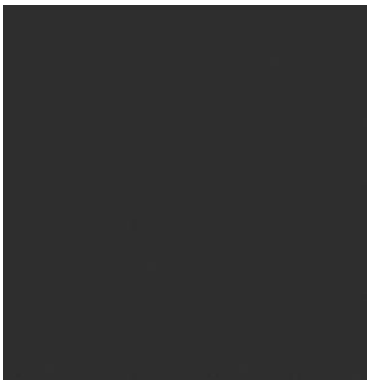
This line of reasoning leads to the second definition of a zone: zones as texture and detail.

My goal is to make it possible for you to look at any photographic subject and say, "In the finished print, I want that tree to be Zone III and the sky to be Zone VI." If you were confident that this could be done consistently, photography would become as straightforward a process as a painter deciding that a tree on his or her canvas should be a given shade of brown. This is what the Zone System is designed to do.

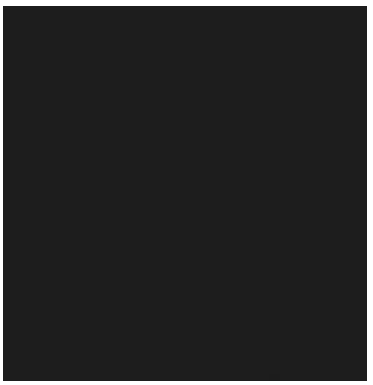
Texture and Detail

To relate zones more closely to the real world, I will define each zone in terms of the way it should look in a normal print. As much as possible, I will refer to familiar objects that typically appear in photographs as certain zones. These descriptions will help you to visualize zones for later use. Of course, you will not always want a given object to appear as a given zone. For example, in one portrait, you may want brown hair to be Zone III and in another Zone IV. And again, these concepts apply to both black-and-white and color images. Keep in mind that offset reproductions can only approximate the tonality of real photographic prints.

The Zones

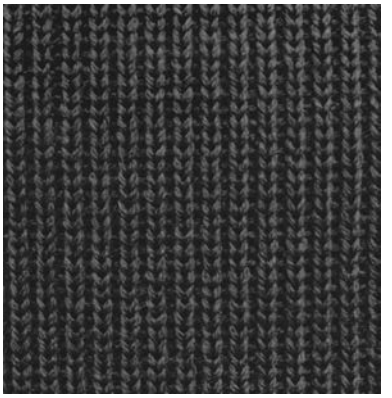


Zone 0 is the easiest to define. It is the blackest black that the photographic paper can produce. Zone 0 has no texture or detail and appears as the most transparent areas of the negative. Because of the slight color added to the film base by the manufacturer to prevent halation and the chemical fog resulting from development, this density is sometimes referred to as "film base plus fog."



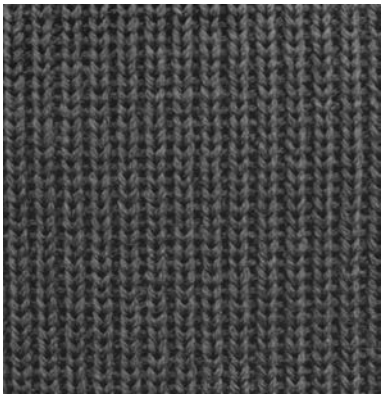
Zone I is also completely without texture and detail. A glance around you will reveal many areas that should be printed as Zone I, including dark recesses or tiny cracks. In a normal print, Zone I would appear to be as black as Zone 0 until you put them side by side.

Zone II is slightly textured black. This is the first zone in which you can begin to detect a trace of texture and detail. If your first impression of an object is that it's black, but you can still see the details of its surface, you can safely assume that it should be Zone II in a normal photograph. Black cloth, black hair, and dark shadows are good examples of Zone II in the real world.

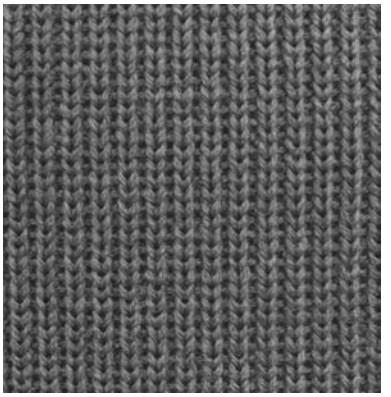


Zone III is extremely important for many reasons, as you will see later. The best way to distinguish between Zone II and Zone III is to remember that Zone II is black, whereas Zone III is instead dark gray with texture and details that are easy to see. Dark foliage, brown hair, and blue jeans are usually perfect Zone III subjects.

[**note**] A common mistake is to consider the darkest shadow you can find in the subject as Zone III. Actually, the darkest shadows in a scene obscure most of the detail in that area and should be rendered as a textured black value in the resulting print. Very dark shadows are generally Zone II. Remember that Zone III is the first dark zone that is fully textured. For this reason, we define Zone III as the zone for Important Shadow Areas (see Appendix Y).

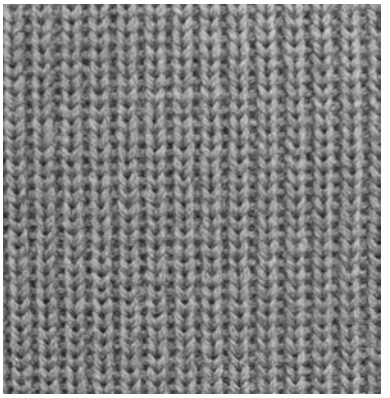


Zone IV is best described as the average print value for dark-skinned subjects. Of course, a variety of complexions are common to dark-skinned people, but generally they fall within Zone IV. Shadows falling on a dark person's skin would be Zone III, and the lighter areas would be Zone V.

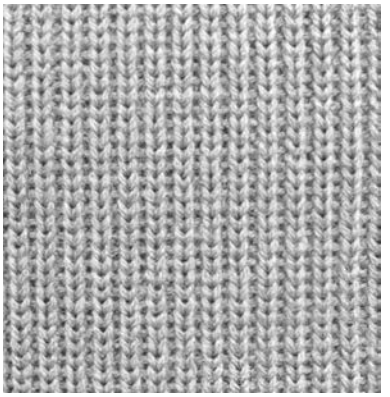


Zone V is fully textured middle or "18 percent" gray. Like most things that are average, Zone V is difficult to describe. A dark blue sky will usually print as Zone V, as will stone in normal light or weathered wood.

As you will learn in the next chapter, Zone V is more important as a reference for determining the correct exposure than it is for visualization. In fact, Kodak manufactures a Neutral Gray Card for use as an exposure guide that is precisely Zone V.



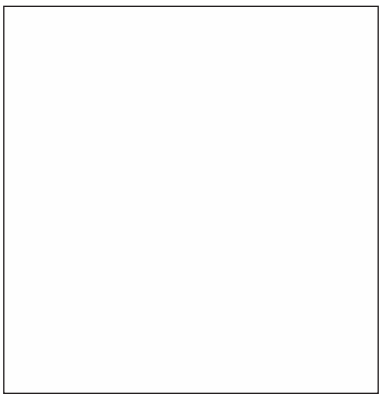
Zone VI is fully textured and easy to describe because you can again relate it to skin tone. Caucasian skin that is not overly tanned usually prints as Zone VI. Shadowed white skin would be Zone V, and the highlights would be Zone VII.



Zone VII is light gray and fully textured. Sunlit concrete and light clothing are normally printed as Zone VII. Zone VII is textured as is Zone III, but on the light end of the scale. Just as Zone III is the first zone that is fully textured and detailed, Zone VII is the last. For this reason, Zone VII is defined as the proper zone for Important Highlight Areas. (See Appendix Y for a definition.)

Beyond Zone VII, the remaining zones become progressively less detailed.

Zone VIII is textured white. Objects such as paper, snow, and painted white walls are often printed as Zone VIII.



Zone IX is pure, untextured white. This is the zone for specular reflections or light sources. The whitest white that the photographic paper can produce is Zone IX.

Our zones are now much closer to resembling the world as we see it, with various amounts of texture and detail in areas that are darker and lighter.

At this point, you should be looking around trying to see the various zones in subjects you may want to photograph. Begin by asking yourself questions such as "In a print, would that wall be Zone IV or Zone V?" It's easy to see how confusing this can be, so to simplify the process of seeing the real world in terms of zones, think of the Zone Scale as being divided into the three distinct sections illustrated in Figure 4.8.

FIGURE 4.8 The Zone Scale's natural divisions.

Any well-lit or textured surface should fall somewhere in the textured range of zones. In fact, you will find that most areas of any normal print are made up of these five textured zones. If the object you are considering is dark and textured, you will want it to print as Zone III or Zone IV. If it is light and textured, such as concrete or light clothing, it must be either Zone VI or Zone VII.

This same line of reasoning can help you easily identify all the other zones. If an area of the subject is black, it will be Zone I or II, depending on the amount of visible detail. If the subject is white and slightly textured (snow or paper, for instance), it will realistically print as Zone VIII. Zone 0 is pure black, and Zone IX is pure white.

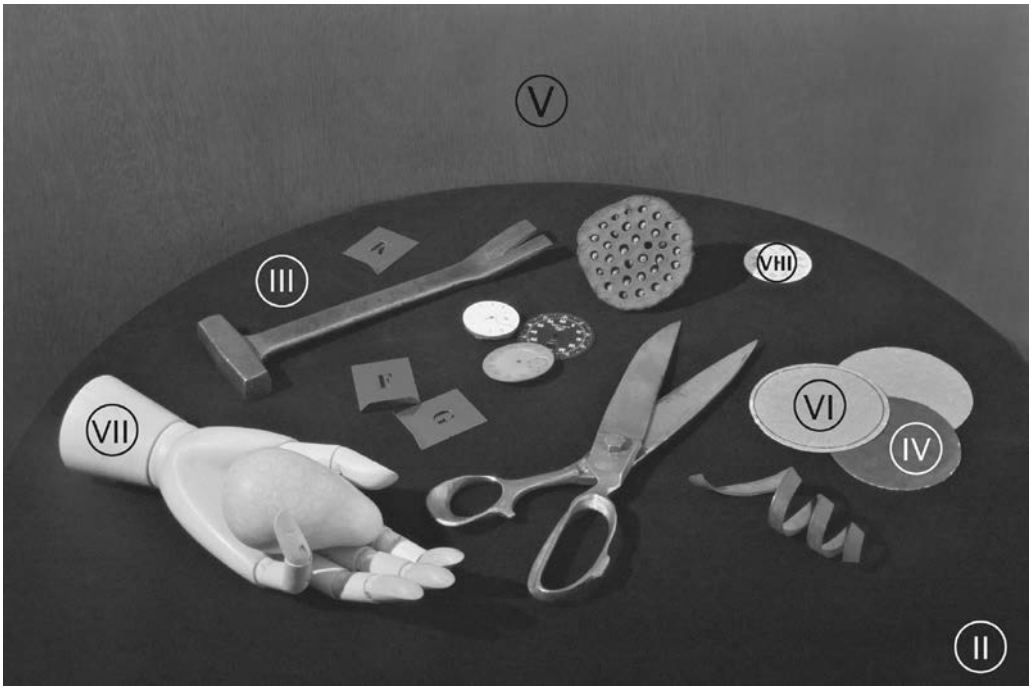


FIGURE 4.9 The zones of a normal print.

Previsualization

Experienced photographers make a number of technical and aesthetic decisions before taking a given photograph. First, of course, there are the general considerations such as deciding whether the photograph should be in color or black and white, a close-up or a long shot, or vertical or horizontal.

What the Zone System does is extend this *before-shooting* decision-making process to include previsualizing the actual tonalities of the final print. This means looking at your subject and *mentally picturing* the way you want it to appear in the photograph that you are eventually going to make. For example, if you are photographing a model with brown hair, you will most likely

want her hair in the finished print to be dark with all its texture showing clearly. In other words, you want it to print in Zone III, or perhaps Zone IV if her hair is light brown.

Deciding beforehand that you would like the model's hair to be no darker than Zone III is important, because if you inadvertently underexpose the film and her hair turns out to be Zone 0, you will be very disappointed.

Very often your intention will be to record the subject just as you see it. However, the range of creative possibilities is limited only by your imagination, and imaginative seeing is exactly what previsualization is all about! Whatever approach you decide to take, either recording your subject as is or interpreting it creatively, previsualizing the print before taking the picture is a very important skill to learn. The better you are able to previsualize the image that you are trying to make, the easier it will be for you to get the results you want.

PREVISUALIZATION EXAMPLES: DRAMATIC AND SUBTLE

The Zone System gives you the freedom to previsualize your subject in a variety of creative ways. You may, for example, want to create abstract images by greatly increasing or decreasing the subject's contrast. Figure 4.10 is an example of how an ordinary beach scene can be dramatically transformed by previsualizing it as a curving white pattern of foam against black sand and water. This image is the result of greatly underexposing and then overdeveloping the negative.

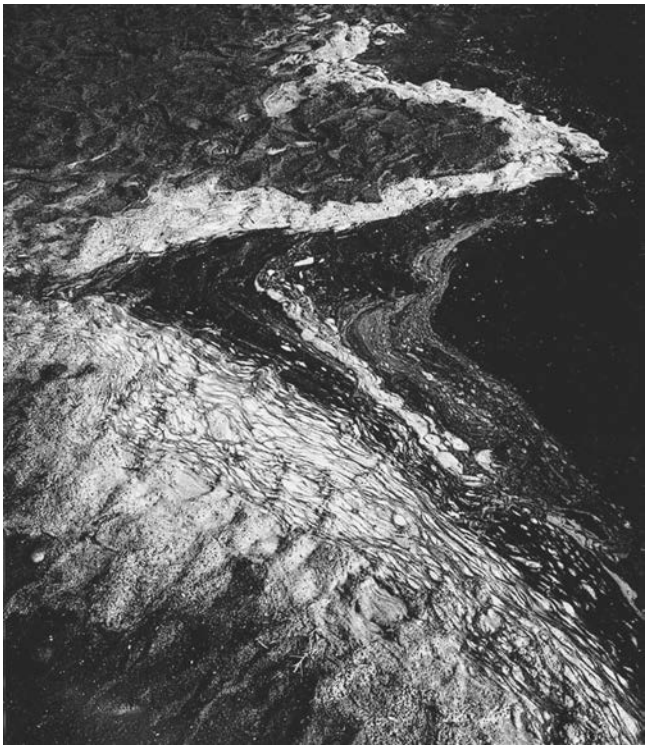


FIGURE 4.10 Beach scene previsualized as a high-contrast abstraction.

You will find, however, that even subtle alterations in the print's tonality or contrast can make an important difference in the overall impact of your image. You could, for example, decide to previsualize the background of your image as darker than it actually was, but still fully detailed. Using Zone System terminology, you would say that the background should be Zone III instead of Zone V.

The example in Figure 4.11B illustrates the difference this simple creative previsualization can make.

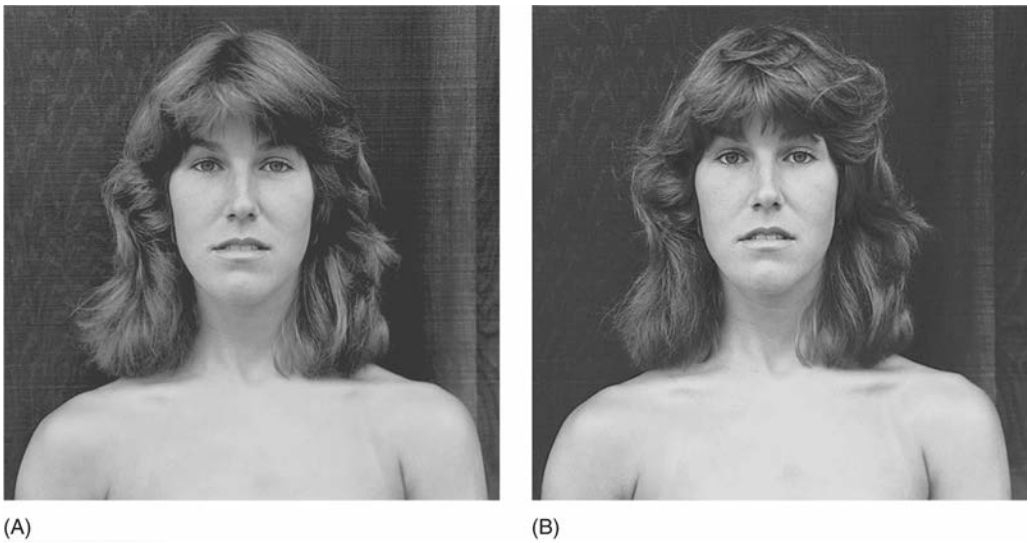


FIGURE 4.11 Two previsualizations of the same portrait.

Both of the pictures in Figure 4.11 were photographed under the same lighting conditions and were printed on the same grade of paper. Figure 4.11A is a normal view of the portrait. The tone of the wooden wall is approximately Zone V. Figure 4.11B was produced by Placing* the wall on Zone III and then expanding the contrast of the negative by increasing its development time.

The darker background and increased contrast of Figure 4.11B draw your attention to the model's face, creating a more striking portrait. Many photographs could be vastly improved by a little forethought. And remember, these examples were done with exposure and development modifications, not through printing techniques.

You may be tempted to think that this process gives film photographers the ability to manipulate images in ways that are normal for digital photographers working in Adobe Photoshop, and in a sense, this is true. Photoshop has image-editing features that allow photographers to expand or compress the tonal separation of images in ways that fine silver printers usually envy. Through previsualization, the Zone System gives film photographers a powerful tool for creative expression.

** See "Placement" in Appendix Y.*

With practice, you will find that previsualizing is not only simple to learn, but also offers you a great deal of creative freedom. The important point to remember is that **the way you previsualize your photograph will ultimately determine the way you will expose and develop your negatives**. The techniques for doing this are described in Chapters 5, "Exposure," and 6, "Development."

The following is an interesting exercise I recommend for photographers who are approaching the concept of previsualization for the first time.

Select a number of your favorite photographs from books, magazines, or your own collection and try to imagine how the actual subject may have looked if you had been at the scene where these famous photographs were actually taken. Is the image completely "natural looking"?

Most likely, what you will discover is that even so-called documentary photographs are actually tonal abstractions that gain dramatic impact or subtle beauty by being somewhat more contrasty or softer than you would expect from natural lighting conditions. The works of Bill Brandt, W. Eugene Smith, Brett Weston, Minor White, Wynn Bullock, or Paul Caponigro are all good examples of this. An exercise of this kind will teach you a great deal about the amount of creative control inherent in the art of photography.

Measuring Zones

The first two definitions of the zone link photographic prints to the visual world. For example, you could now say, "I want that person's face to print as Zone IV." The third definition of the zone establishes the same kind of relationship between zones and the tools of our trade, the *camera* and the *light meter*.

[**note**] For now, I will limit my discussion to the uses of handheld light meters because, in some ways, these are the most functional for use with the Zone System. A detailed explanation of the application of the Zone System with built-in camera meters appears in the next chapter.

At this point, the important question is: How do zones relate to f/stops, shutter speeds, ASA numbers, and the numbers that light meters use to measure brightness?

The answer is that all these controls measure equal amounts of light. **F/stops, shutter speeds, meter numbers, ASA/ISO numbers, and zones all measure light according to a ratio of 2 to 1.** This means that whenever you see two of these numbers side by side, one represents *twice* as much light as the other. For example, f/8 exposes the film to *twice* as much light as does f/11 and *one-half* as much as f/5.6.

[**note**] Keep in mind that for these examples I'm referring to the classic whole f/stops and shutter speeds rather than the incremental numbers that appear between them on some meters.

Another way of saying this is that f/stops, shutter speeds, ASA/ISO numbers, and meter numbers all measure amounts of light that double going in one direction and halve going in the other. The ratio of light measurement between all whole photographic settings is 2 to 1.

ZONES	0	I	II	III	IV	V	VI	VII	VIII	IX
1. UNITS OF LIGHT	½	1	2	4	8	16	32	64	128	256
2. EXPOSURE VALUES (EV)	0	1	2	3	4	5	6	7	8	9
3. RELATIVE f/STOPS	F/64	F/45	F/32	F/22	F/16	F/11	F/8	F/5.6	F/4	F/2.8
4. RELATIVE SHUTTER SPEEDS	1/250	1/125	1/60	1/30	1/15	1/8	1/4	1/2	1 sec.	2 sec.
5. RELATIVE ASA	6400	3200	1600	800	400	200	100	50	25	12

FIGURE 4.12 The equivalence of zones, meter readings, f/stops, shutter speeds, and ASA numbers.

Zones follow the same rule: Zone V represents twice the amount of light as Zone IV, one-half as much as Zone VI, and so on up and down the scale. This concept may sound complicated at first, but take a careful look at the chart in Figure 4.12.

Line 1 is labeled "Units of Light." Notice that Zone I is directly over 1 unit, Zone II over 2 units, and so forth. This indicates that if Zone I were said to equal 1 unit of light, Zone II would equal 2 units, Zone III would equal 4 units, Zone IV would equal 8 units, and so on. Their progression is **geometric**, meaning that each number **doubles** as it progresses upward.

In other words, the actual amounts of light the zones represent **doubles** as the zones get **lighter** and **halves** as the zones get **darker**. This is what is meant by a ratio of 2 to 1. Make sure that this is clear before you continue reading.

Line 2 shows that although the numbers you see on the dials of certain handheld meters progress arithmetically (1, 2, 3, 4, 5, etc.), they also represent amounts of light that increase geometrically. If meter number 1 equals 1 unit of light, meter number 2 will equal 2 units, meter number 3 will equal 4 units, and so on. This means that if you aim your meter at one wall and it reads number 6, and then you aim it at another wall and it reads number 7, the second wall is reflecting *twice* the amount of light when compared with the brightness of the first. Meters are designed this way because the manufacturer wants to avoid putting large numbers on the dial. Following the preceding analogy, meter number 11 would equal 1,024 units of light. Meter numbers of this kind are called EV numbers, or "Exposure Values."

[**note**] EVs are standard from one meter to the next, but some light meters use numbering systems that are arbitrary because an amount of light that might read number 10 on my meter could read as number 8 on yours. The same amount of light is being measured, but the numbers are different because the light meters were made by different companies.

Lines 3 and **4** show that f/stops and shutter speeds are also calibrated according to a ratio of 2 to 1. The numbers themselves don't always double, but the amounts of light that they measure do.

[**note**] F/stops and shutter speeds are labeled as "relative" because this chart intends to show how these numbers relate to each other; in other words, that they all measure equal amounts of light. Do not read this chart as indicating that f/11 at 1/8 will always give you Zone V. Your actual exposures will depend on the amount of light in your scene.

Line 5 illustrates that ASA numbers are also calibrated according to this ratio. If one film is rated **ASA 200** and another **ASA 400**, the second film is **twice** as sensitive as the first. In other words, it takes **one stop more exposure**, or two times the amount of light, for the first film to give the same results as the second. The rule to remember is: Using **half** the ASA number (ASA 400 to ASA 200) is the same as **doubling** the exposure; **doubling** the ASA cuts the exposure in **half** or, in other words, reduces it by **one stop**.

The fact that zones fit neatly onto this chart has far-reaching implications. Think through the following example very carefully.

Suppose you are photographing a scene with two walls and you wanted to know how much darker one wall was than the other. For the sake of this example, let's say that the meter reading you got for the light wall was 1/60 at f/11, and for the dark wall it was 1/60 at f/8. Later we will discuss the logic behind why the meter is recommending more exposure for the dark wall and less for the light wall, but for now it's enough to understand that you could either say that there is a one full f/stop difference in brightness between these two walls, or a one**-zone** difference. For the purposes of contrast measurement, the two terms are interchangeable!

By remembering that each meter full f/stop or shutter speed equals one zone, you can measure the contrast of any scene in terms of zones.

If, instead of using f/stops and shutter speeds, you were to use EV numbers to measure the contrast of your subject, you might discover that the lowest meter reading you can find in a given scene is EV number 3. If the highest reading is EV number 10, you could describe this scene as having eight stops' worth of contrast, or eight zones' worth of contrast.

As an exercise, try measuring the range of contrast in a variety of situations in terms of zones. Gradually, the equivalence of zones, meter numbers, f/stops, and shutter speeds will become clear.

Summary

Let's briefly review what you have learned about zones in this chapter.

ZONES AND THE PRINT

Starting with a continuous gradation consisting of all the possible tones in a print from black to white, zones are formed by following this procedure:

1. Divide the spectrum into 10 equal sections.

Ten-step divided gradation.

2. Blend each section into one tone that represents all the tonal values in that section.

Ten symbolic tones.

3. Number each section with Roman numerals from 0 for the black section to IX for the white one.

The Zone Scale.

TEXTURE AND DETAIL

1. In a fine print, each zone has a different amount of texture and detail. There are three types of zones:
   a. Zones that have no texture and detail that are used to represent extremely dark or pure white objects in a photograph (Zones 0, I, and IX);
   b. Zones that have a limited amount of texture and detail that are used to represent very dark or light objects that are slightly textured (Zones II and VIII); and
   c. Zones with full texture and detail that make up the greater part of most photographs (Zones III, IV, V, VI, and VII).
2. Zones help us to mentally picture the subject being photographed in terms of the final print that we hope to make. This is called previsualization. Remembering how zones look in terms of subject matter makes previsualization relatively easy.

MEASURING ZONES

Zones represent amounts of light that double as the zones become lighter and halve as they get darker. In this sense, zones are equivalent to all other photographic controls. One zone equals one whole f/stop or shutter speed, one EV meter number, and ASA numbers as they double and halve. This equivalency allows you to measure the contrast of any scene with f/stops, meter numbers, or zones. For the purposes of the Zone System, they are all the same.

You can now see how the Zone System provides photographers with a reliable way to translate what they see or imagine into print zones that directly relate to that initial experience. But understanding what zones are is just the beginning. What you now need to learn is how the Zone System of exposure actually works.

chapter **five**

Exposure

To understand how Zone System theory applies to exposure, let's first consider the different types of light meters available and how they function.

Light meters come in two general types: Meters that measure what is called incident light and meters that measure reflected light.

Incident-light meters measure the light that falls on the subject from the source of light (see Figure 5.1). Incident-light meters are especially useful in lighting studios or on movie sets where the contrast can be controlled with fill-lights or reflectors. Under those conditions, your primary concern is to make sure that the amount of incident light falling on your subject does not change from one shot to another.

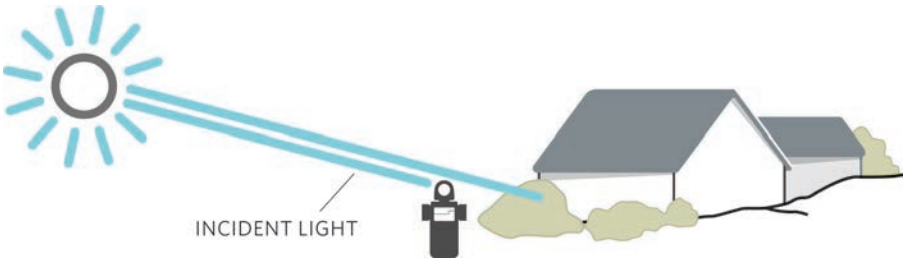


FIGURE 5.1 Incident-light reading.

Reflected-light meters measure the light that bounces off the subject to the camera and film or digital sensor (as in Figure 5.2).

As we discussed earlier, with the Zone System, we are primarily interested in measuring the contrast of a given scene. The question is: How much light is coming from one area as opposed to another? Only a meter that measures reflected light can tell us this difference.

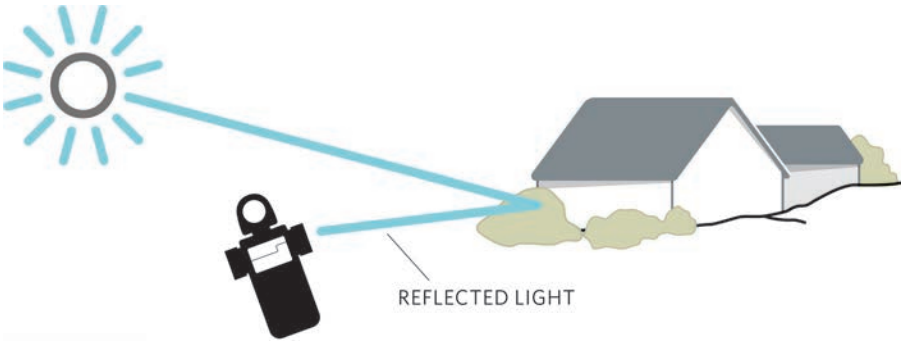


FIGURE 5.2 Reflected-light reading.

There are three different types of reflected-light meters: spot meters, wide-angle meters, and built-in camera meters. Light metering applications that run on IOS or Android smartphones are similar to built-in camera meters in that the ways in which they measure reflected light depends to some extent on what the camera is seeing when it is aimed at the subject.

The first two types of reflected meters differ in terms of what is called their angle of incidence.

A wide-angle meter "sees" at an angle of approximately 30 degrees, whereas a spot meter reads at an angle of only 1 degree or less in some cases (see Figure 5.3).

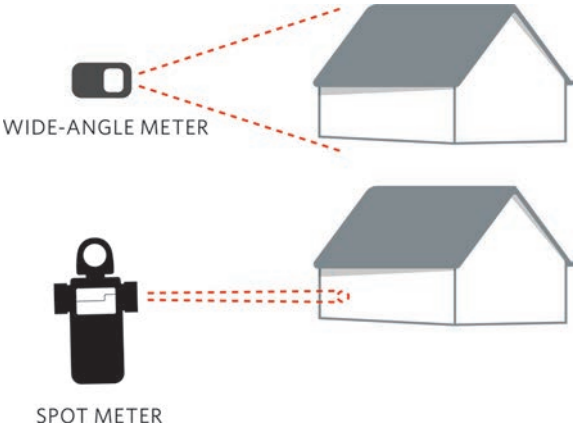


FIGURE 5.3 Wide-angle and spot meters.

This difference in the angle of incidence is similar to the difference between looking through a straw as opposed to looking through a cone. The advantage of using a spot meter is that it allows you to measure the light from small, isolated areas very accurately at a distance. Imagine that you need to know how much light is being reflected by a model's face. With a wide-angle meter, you would have to get very close to avoid including her hair in the reading. This is less of a problem if you can approach the subject, but if you are photographing distant mountains or performers on a stage, a wide-angle meter can make getting an accurate reflected reading very difficult, if not impossible.

The "acceptance angle" of a built-in meter varies depending on the kind of meter the camera uses and the focal length of your lens. Smartphone metering apps sometimes offer the ability to isolate small areas of the phone camera's view. (Check the app's manual to verify this feature.)

Thus far, I have talked about "exposing for the shadows" or "making the background Zone III" without explaining how this is actually done.

The problem of how to calculate the proper exposure becomes easy when you understand more about what all light meters are actually designed to do.

Light meters are programmed to perform two different but related functions: **light measurement** and **exposure recommendation**.

Light Measurement

The first responsibility of any light meter is to simply measure the quantity of light being reflected by the subject. Many light meters measure light using Exposure Values, or EV numbers. As you saw in Figure 4.12, EV numbers provide a very simple and intuitive way to measure amounts of light: The lighter the surface measured, the higher the number.

You also learned that because EV numbers and zones both measure amounts of light that double as they increase, you can use one to represent the other. If one surface reads EV #7 and another EV #8, you could either say that they are one EV number apart or one zone apart.

[**note**] Because of the conceptual simplicity of this method, many of the examples that follow will use EV numbers to illustrate the various principles being explained.

In Figure 5.4, the representation of a digital spot meter shows that the bush being read is reflecting 15 EV units of light. If the sun came out and the bush were reflecting twice as much light, the meter would read it as EV 16. Remember that unless these are EV numbers, they are arbitrary. On another meter, the same amount of light might be number 11.

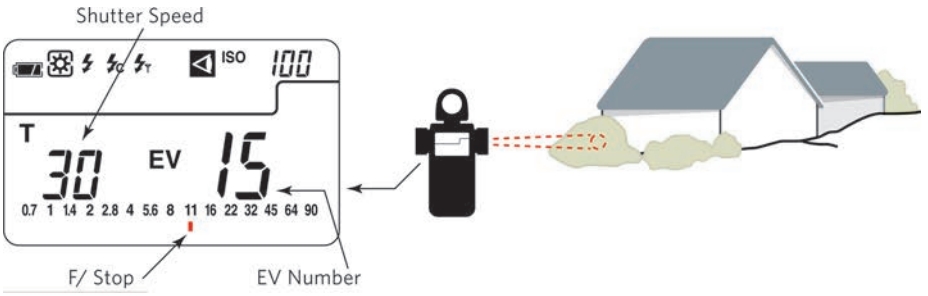


FIGURE 5.4 Digital meter reading.

Digital light meters like the one illustrated in Figure 5.4 often have an LCD screen that simply displays its recommended exposure. In this case, the shutter speed is displayed as a number (1/30), and the red marker moves to indicate the aperture it suggests that you should use (f/11).

When in-camera light meters are in their manual mode, they measure quantities of light through "nulling" systems of one kind or another. Figure 5.5 illustrates one example. Figure 5.5A is the way an in-camera metering system would indicate 1 EV "overexposure." Figure 5.5B indicates two stops' "underexposure." Figure 5.5C indicates the "correct" exposure.

FIGURE 5.5 In-camera meter readings.

With other in-camera systems, turning the aperture or shutter speed dial may cause a needle or red dot to move up or down until you see that the dot is in the center of a scale, or perhaps a needle is lined up with a ring.

Whichever system the meter uses, all it is doing is indicating that either more or less light is reflected by whatever is in the meter's field of view.

Exposure Recommendations

The second thing a light meter does is to convert its light reading into an exposure that you will use to take the picture. It's as if the meter were saying "I can see that the bush is light gray (and reflecting 15 EV units of light—the measurement), so I'm recommending that you use this combination of aperture and shutter speed (f/11 at 1/30—the exposure) to make it look that way in your print."

Analog handheld light meters have an indicating arrow or pointer you use to line up opposite the indicated meter number. When this is done, the meter's dial turns and matches an f/stop with a shutter speed for the "correct" exposure.

In Figure 5.6, the meter's indicated exposure is f/11 at 1/30 of a second.

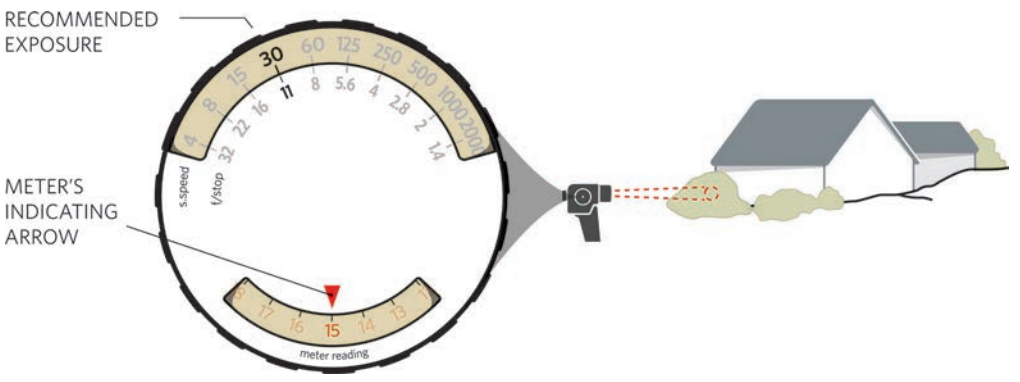


FIGURE 5.6 Analog meter reading with an indicator arrow.

As I mentioned previously, in-camera meters combine these two functions because to center the meter's light measuring symbol, you have to match an aperture with a shutter speed, and this is the meter's recommended exposure.

The Meter's Dilemma

Unfortunately, finding the correct exposure isn't always that simple. The problem is that light meters have no way of actually "seeing" the objects they measure. An exposure meter is simply a device that measures quantities of light, and the problem is that both a light surface and a dark surface will reflect the same amount of light if the light falling on them is changed. For example, on a bright, sunny day, a dark wall might read meter number 11, but so might a light wall on a cloudy day! To your eye, the light and dark walls are obviously very different, but to the meter, they are both meter number 11.

Think about this for a minute. "Seeing" is a complex process of visual perception that is much more than simply measuring amounts of light. For example, a piece of white paper looks white to you in both a bright light and a dimly lit room. The light meter is responding to the change in the incident light, but you can judge that the dark wall should print as Zone III and the light wall as Zone VII.

Unfortunately, the meter still has the responsibility of suggesting the correct exposure for you to use. In this example, given that the meter reads both the dark and the light walls as number 11, it obviously cannot suggest the different exposures that the two walls would require. Light meters are designed to get around this problem in a simple way: They lie!

Because the meter might read a dark wall and the white wall as the same reading if the light falling on them changes, it will simply pretend that both walls are **middle gray**. In this way, the exposure that it recommends can, at worst, be only half-wrong. Of course, if the wall had been gray in the first place, the meter's recommended exposure would have been perfect.

The fact is that all light meters are programmed to give you an average gray exposure for whatever amount of light they are measuring.*

In the language of the Zone System, we would say that **all light meters will automatically place any light reading on Zone V**. This is very important for you to understand and remember.

This principle explains why the exposures I used in the previous chapter changed the way they did. Remember that I said that the meter reading for the white wall was 1/60 at f/11 and for the black wall was 1/60 at f/8. In both cases, the meter is suggesting an exposure that will make each wall print as middle gray. If you want to make a black wall print gray, the meter has to recommend an exposure that makes the black wall lighter. (Gray is lighter than black.) Conversely, if you want to make a white wall gray, the meter needs to recommend an exposure that makes the wall darker. (Middle gray is darker than white.)

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* *Some exceptions to this rule will be discussed later.*

At this point, you may be finding it hard to believe that light meters are designed to mislead you in such a dramatic way. For this reason, I would like to suggest that you try one or both of these two very simple demonstrations that will illustrate how this works.

The first is a demonstration you can do with any cellphone camera and two evenly lit surfaces—one pure white and the other pitch black.

[**note**] For this demonstration you should not use a light-metering app on your phone. The phone camera itself will make for the best demonstration of this effect.

All you have to do is position the camera so that all it can see is the white surface. You would expect the image on the camera's screen to be white, but instead, as you can see in Figure 5.7, it is gray.

If you repeat this process with the camera pointed at a black surface, you will again see that the image on the screen is gray.

FIGURE 5.7 Phone camera rendering of white surface.

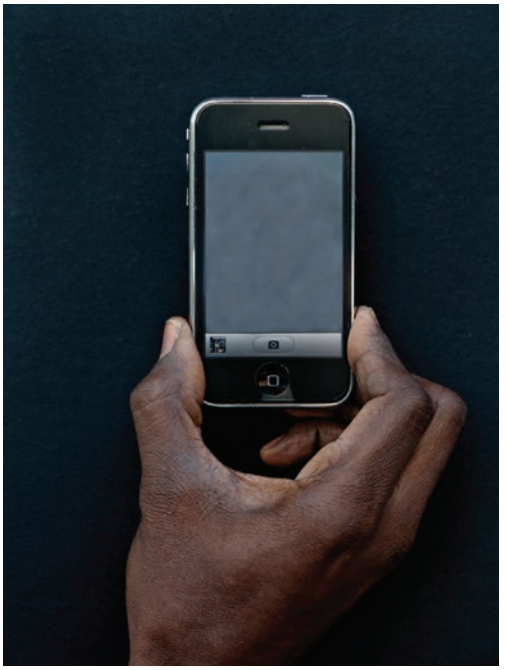

FIGURE 5.8 Phone camera rendering of black surface.

In both cases, the images rendered by the camera will be much closer to each other than they are to the original surfaces.

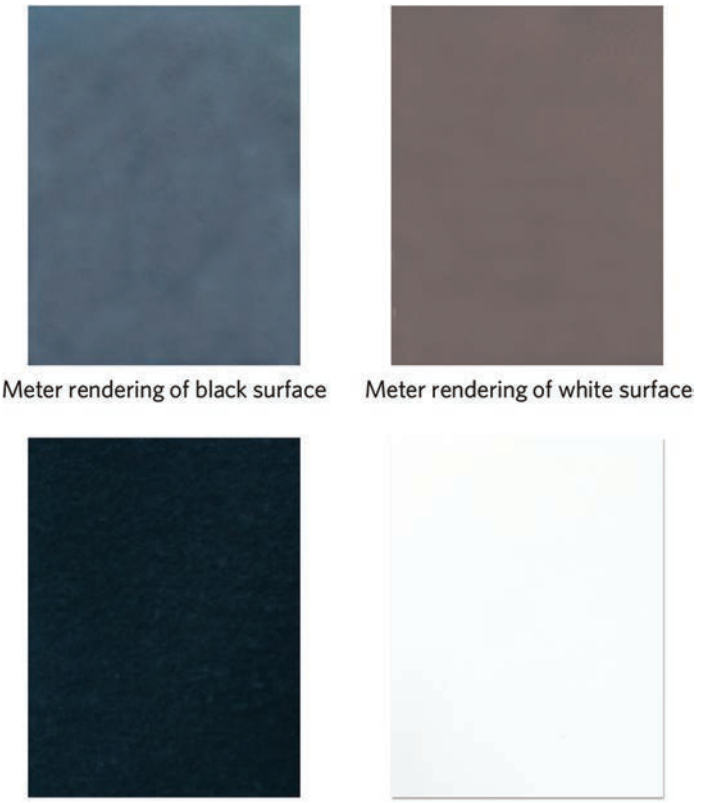

FIGURE 5.9 Phone camera renderings compared with black and white surfaces.

The light meters built into all cellphone cameras are very sophisticated, so this is a perfect demonstration of the way all lights meters work.

As simple and direct as this demonstration is, I strongly recommend that any reader approaching the Zone System for the first time consider working through the following, more elaborate exercise from beginning to end. You can do this with your own camera and film to illustrate how this works. This example will not only graphically illustrate the way light meters operate, but will also function as an ideal warm up for Zone System testing.

Before you begin, it is a good idea to have your light meter and shutter speeds tested for accuracy and consistency. If your technician advises you that your equipment tests within reasonable limits, proceed with this demonstration. If not, leave the equipment with the technician to be adjusted.

Exercise: How Light Meters Really Work

To do this exercise, you need five frames on any roll of film, two walls (a light one and dark one), and a reflected-light meter. A "Zone V" Neutral Gray Card from Kodak will be useful when you make a contact print of these test exposures.

Readers with digital cameras can also do this exercise using their preview window to see the results.

In choosing your test subjects, try to select walls that match your mental image of Zone IV for the dark wall and Zone VI for the light wall. This will be your first exercise in previsualization. It is very important that you find evenly textured surfaces and that you fill the frame of your camera with only those areas before you shoot. Be careful not to include your shadow in the image.

If your camera is equipped with an automatic built-in meter, you will have to either set it to its "Manual" setting or override the automatic function; otherwise, when you stop down one stop, for example, the meter will automatically change the shutter speed to one step slower to be able to maintain its Zone V exposure. Check your owner's manual if you are not clear on how this is done with your camera. (See Chapter 7, page 84 for a discussion of how to override automatic built-in light meters.)

EXPOSURE PLAN

Frame 1 Take a careful meter reading of the dark wall and make an exposure of only that surface using the meter's recommended f/stop and shutter speed. With built-in meters, center the dot or arrow of the meter and shoot.

Frame 2 Make an exposure of the same dark wall using an exposure that is one stop less than the first. Do this by either stopping down one f/stop from the first exposure or using one shutter speed faster. I will explain the purpose of this adjustment later in this chapter. The goal of this step of the exercise is to "underexpose" the film by one stop (Zone IV) when compared to the exposure used for frame 1.

Frame 3 Carefully meter and shoot the light wall using the meter's recommended exposure.

[**note**] Be sure to take your light reading at the same angle you intend to shoot the picture and that you use the correct ASA for the film you are using. If your camera has a compensation control dial, be sure to set it at zero.

Frame 4 Photograph the light wall using an exposure that is one stop more than the meter's recommended exposure. For frame 4 you will be overexposing the film by one stop (Zone VI) when compared to frame 3.

Frame 5 Put the lens cap on your lens and shoot one blank frame.

Process this roll of film using your standard development time and make a contact print of your five test frames. Choose an exposure time for this contact print that is the minimum amount of exposure under the enlarger that it takes to make your blank frame (frame 5) as black as it will get. To find this time, make a series of test exposures at 2-second intervals across frame 5.

The first exposure step that turns this unexposed frame as black as the paper will get represents your minimum time for maximum black. For a detailed explanation of this procedure, see Chapter 8, "Zone System Testing: Method 1."

Your four other test frames should something look like Figure 5.10.

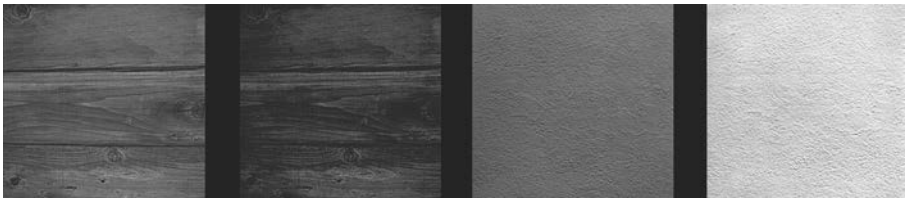

FIGURE 5.10 Zone placement test frames.

Notice that frames 1 and 3 are very similar in tone (they should approximately match your Neutral Gray Card). The reason is that the meter is blindly trying to give you the "correct" exposure by averaging the dark and light values of the walls to middle gray (Zone V).

Frames 2 and 4 should be much closer to the actual tonal values of the original walls.

[**note**] A valuable extension of this demonstration would be to expose two rolls of film in exactly the same way using the procedure described previously. Develop the first roll using your standard development time and the other at a time that is 20 percent longer. Contact both rolls at times that allow the first and third frames to match your Neutral Gray Card. What you will notice is that while the frame 2s on both rolls are very similar in tone, the frame 4s are noticeably different: The frame 4 (in Figure 5.10) that has been developed for 20 percent longer is noticeably lighter. This illustrates the effect of increased development on the highlight values, as described in Chapter 3, "The Control of Negative Contrast."

THE RESULTS

What this demonstration shows is that the camera's built-in meter is programmed to render any single subject value as an average middle gray tone, or Zone V, regardless of how dark or light it may actually be. With a few exceptions I will discuss later, all light meters are designed the same way.

What you should have learned from this demonstration is that if you were always to follow the meter's recommendations, it would be a classic case of the blind leading the blind: You see the wall as a dark value, the meter sees it as gray, and the meter's choice prevails. To consistently achieve the correct exposure for any subject, you need a way to tell the light meter how you want the walls to print. When you apply all that you have learned thus far, the method for doing this will seem very simple.

To demonstrate the Zone System method of exposure, imagine that Figure 5.11A is an actual subject sitting in front of you and you are trying to photograph her.

FIGURE 5.11A Normal print.

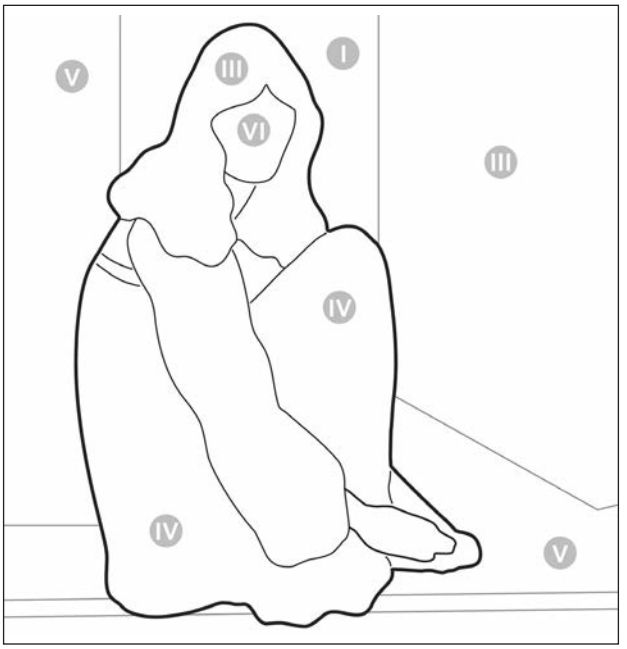

FIGURE 5.11B Zone previsualizations of Part A.

Exposure Detailed

The first step in the process of correctly exposing any photograph is always previsualization. Sometimes this is an explicit, intentional process; at other times it's simply a sense that you would like the final image to faithfully render what you are seeing.

If you want to correctly expose a given subject using the Zone System, the important question you need to ask yourself in most cases will be "What part of this picture do I want to print as Zone III?" Zone III is important because it is the darkest zone that shows full texture and detail. Remember this rule: **Expose for the Shadows.** Take a careful look at Figure 5.11A. Imagining that this is an actual scene, which areas would you judge to be Zone III? The obvious answers are the model's hair and the darker parts of the door on the right. For brown hair to print realistically, it has to be detailed enough to show individual strands. This automatically indicates Zone III. Blond hair is closer to Zone VII.

Place and Fall

The concept of zone "Placement" is extremely important in Zone System theory because it describes the process that will ultimately determine what aperture and shutter speed you will use for your exposure. In any photographic subject, you will always find some dark area that, in your opinion, absolutely needs adequate texture and detail. This part of your image is called the **Important Shadow Area**. After you have identified the Important Shadow Area, your goal in most cases will be to choose an exposure that will render that area as Zone III in the finished print. This is called "Placing the Important Shadow on Zone III" (see Figure 5.11B). Remember that Zone III is the first dark zone that has full texture and detail. Also remember that Zone III is not black.

When you decide to place a particular area of the subject on Zone III, you are saying in effect that you will not mind if any inherently darker area of the scene is black or nearly black in the finished print. Another way of putting this would be to say that after the Important Shadow has been placed on Zone III, darker areas of the subject will "Fall" on Zones 0, I, or II. The dark interior behind the model's head in Figure 5.11A is a good example of an area that should logically fall below Zone III. You can see why the placement of Zone III is so important. Placing Important Shadow Areas of your subject too low on the Zone Scale is an excellent way to define underexposure. In this example, the model's hair would be lost against the dark interior of the building if it were placed on a zone lower than Zone III.

Areas of the subject that are inherently lighter than the placed shadow value will, of course, fall on zones above Zone III. If the Important Highlight Areas of your subject fall above Zone VIII, they will be too white in the print, or "blocked up," as we say. The relative positions of all the values in the subject are determined by the placement of the Important Shadow Area on the Zone Scale. If you place your shadow value on a lower zone, all the other subject values will be darker. Placing the shadow value higher on the Zone Scale will cause the rest of the subject values to be lighter. I will discuss further implications of this statement in Chapter 6, "Development."

Once you have decided on the placement of Zone III, after you carefully meter only that area, the last step is choosing the correct f/stop and shutter speed.

There are only two points you need to remember.

With Handheld Meters

1. Whatever light measuring system your meter uses, it will recommend an exposure that will print as Zone V unless you change it.
2. Each meter number is equivalent to one zone and/or one f/stop or shutter speed.

With In-Camera Meters

1. Once again, the meter's recommended exposure (when you center the needle or dot) will place whatever the meter is reading on Zone V.
2. Each full f/stop or shutter speed is equivalent to one zone.

An additional point to remember with in-camera meters is that they take light readings in two different general ways: automatic and manual.

All the various automatic settings (Aperture or Shutter Priority or Program) will give you a Zone V placement for whatever the meter is seeing, regardless of how you change the settings. This is why it's crucial that you set the meter to Manual so you can control the way it renders its reading.

The first step in determining the correct exposure in this example is to carefully meter the model's hair (previsualized as Zone III). With a spot meter, you could obtain an accurate meter reading of her hair without leaving the position of the camera. With a wide-angle or built-in meter, you would have to get close enough to the model for her hair to fill the meter's field of view. You would also have to avoid including the shadow of your hand in the reading. As illustrated in Figure 5.12, the spot-meter reading for the model's hair is EV 9. If you were to blindly follow the meter's instructions, the recommended exposure for this portrait would be f/11 at 1/30 of a second at ISO 100.

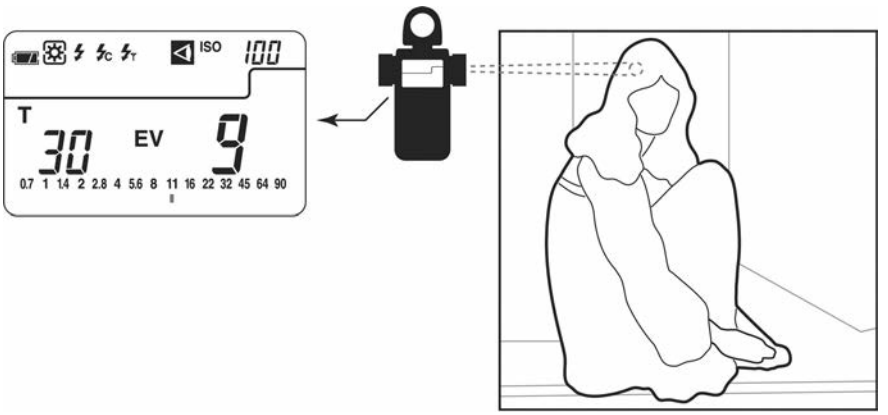

FIGURE 5.12 Zone V placement of EV number 9 (the model's hair). Meter recommended exposure: f/11 at 1/30 of a second.

[**note**] Remember that in-camera light meters don't have meter numbers and instead translate light readings directly into recommended f/stop and shutter speed exposures. This will be discussed shortly.

Because the meter's recommended exposure will cause her hair to print as Zone V (in this case, two zones lighter than you want it to be), if you **stop down two stops** from this suggested exposure (from f/11 to f/22), you will be placing the meter reading of her hair (EV 9) on Zone III, which is the way it should be printed.

Figure 5.13 illustrates how a digital meter would look with this new placement.

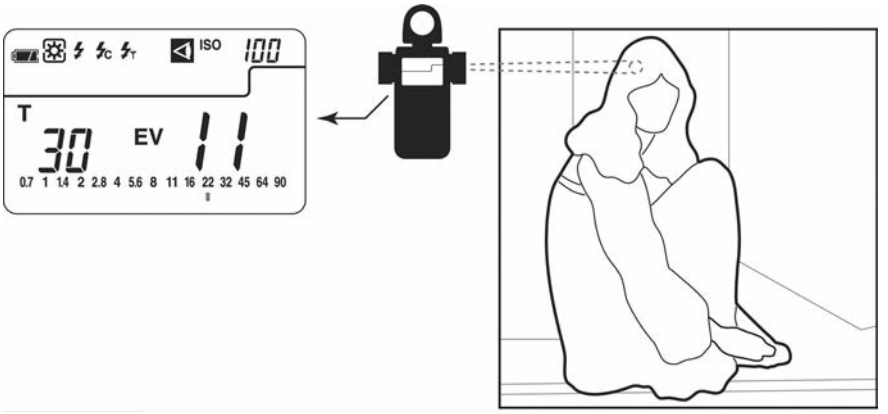

FIGURE 5.13 Zone III placement of EV number 9 (the model's hair). Meter recommended exposure: f/22 at 1/30 of a second.

This is a key point, so let's consider this step very carefully.

There are two factors that often make this process confusing to people new to the Zone System. The first is the logic of why the system works the way that it does.

The second confusing factor is the different methods that you have to use to adjust different light meters to make the system work.

ZONE SYSTEM EXPOSURE LOGIC

First, after you have dutifully followed light meter suggestions for so long, it may be disconcerting to suddenly find yourself apparently underexposing from the reading the meter is providing you. But remember, the meter reading you are adjusting was based only on **the specific area of the subject that you'd like to appear as Zone III (dark with full texture) in your final print**. In this case, it's the model's hair. The meter's recommendation for the whole scene would most likely have been very different.

Second, the reason that you stop down two stops from the meter's recommended exposure is that, as you learned, the meter's recommendation would print her hair as Zone V. Therefore, one stop less exposure would render her hair as Zone IV, and **two stops less exposure will place her hair on Zone III**, which in this case is the way you want it to look in the final print.

Of course, you could use either whole f/stops or shutter speeds to make this adjustment because zones, shutter speeds, and f/stops are equivalent. The corrected exposure in this example would then be f/22 at 1/30 of a second, or any exposure equivalent to this one.

Your concern with determining the exposure of this portrait ends here. The model's hair and the door have been safely placed on Zone III (in this example, the meter reads them both as the same meter number), and the darker parts of the scene are falling on the lower zones where they belong.

APPLYING THE ZONE SYSTEM TO DIFFERENT LIGHT METERS

The second confusing factor is learning how to use various types and brands of light meters to make the system work. For example, you may be wondering why the EV reading in Figure 5.12 is 9, whereas the EV number in Figure 5.13 is 11. Here's why.

If you decide to Place EV number 9 on Zone III, then EV number 10 will Fall on Zone IV, and EV number 11 will Fall on Zone V. **And digital meter dials always display the Zone V EV number.**

This concept becomes easier to understand if we were to present it on a chart similar to the one in Figure 4.11 in the preceding chapter.

FIGURE 5.14 Zone III placement of EV number 9.

Until now, I've used representations of digital light meters as illustrations because they are what readers are more likely to own. But analog meters such as the classic Pentax Spotmeter V display their EV readings and recommended exposures in a very different way.

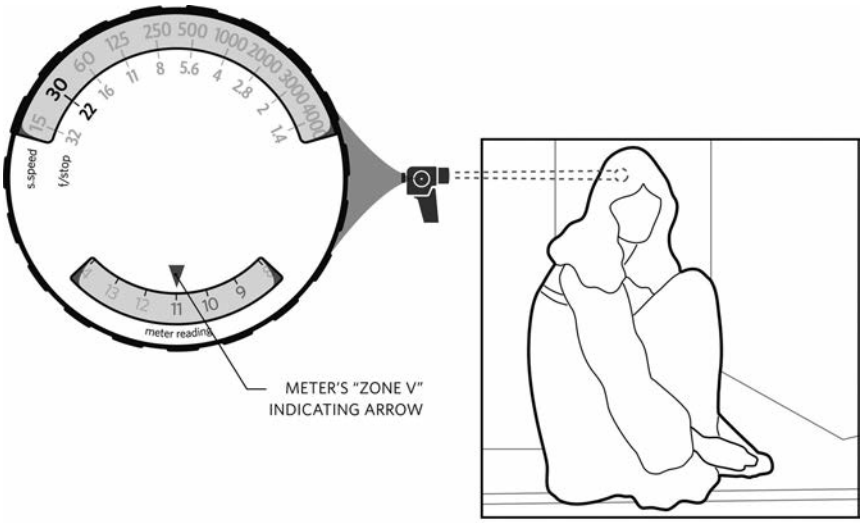

FIGURE 5.15 Zone III placement of EV number 9 (the model's hair). Analog meter recommended exposure: f/22 at 1/30 of a second.

As you can see, the logic of the way EV numbers relate to recommended exposures is much more clear in this illustration because the EV numbers are visible, whereas with digital meters they are replaced with updated Zone V readings.

Because meter dials like this one makes the Zone System much easier to understand, we will use illustrations like this one in the next few chapters.

Digital meter owners should refer to Appendix F to see in detail how the following examples apply to their meters.

Using Smartphone Light Meters with the Zone System

As of this writing, there were nine different light metering applications I was able to review, and although their interfaces differ, they all share a variety of advantages and disadvantages for use with the zone system.

The first and most obvious advantage is that they are very inexpensive and, given the ubiquity of cellphones in our lives, you are likely to have a meter available when you need one.

Another advantage that some of these applications share is that they have a semi-spot meter function that allows you to move the position of a small bracketed area within the camera's view so that you can cause the meter to offer you a reading of that isolated area. What you will notice when you select a brighter part of your image is that that specific area will darken to approximately middle gray and the rest of the image will be correspondingly darker. And of course the reverse happens when you select a darker part of your image.

Given what we've learned about the way that all light meters function, these behaviors should now make perfect sense.

Most of these applications provide easy-to-read displays of the apertures and shutter speeds they are recommending and they also allow you to lock either one of these so you can watch only one or the other change.

The primary disadvantages I discovered when using all of these applications is that they are, of course, dependant on the inherent accuracy of the light metering system built into the camera itself. Smartphone cameras are improving very quickly, so it would not be surprising if cameras in the future were much better than the ones available now.

Also, although the selected metering area is small in relation to the whole view of the phone's camera, it was still much larger than the 1 degree area of my spot meter.

Given these variables, my testing showed that the exposures recommended by these apps were one or two stops different than the exposure recommended by my spot meter.

One very useful feature is that some of these apps offer exposure compensation functions that allow you to essentially calibrate the recommended exposures so that they more closely agree with a professional, stand-alone light meter.

Taking these factors into consideration, it would then be possible to use any smartphone light metering app just the way you would with any other built-in camera meter; the process would be to:

1. Make sure that your metering app is set to the ISO of your chosen film.
2. Use your phone camera to frame your subject so that the camera image approximates your chosen composition.

An alternative would be to get close enough to your Important Shadow Area so that your phone camera and meter are only seeing that part of your composition.

3. As much as possible, select the Important Shadow Area of your subject and make note of the exposure your phone meter recommends.
4. Remembering that this recommended exposure would place the reading for that area on Zone V, place that exposure on the zone you previsualize.
5. For example, if you previsualize that area as Zone IV you would use an exposure that is one stop less than your phone meter is recommending.

Summary

Unfortunately, explaining this procedure in detail makes it appear much more complicated than it really is. In essence, all you have really done is:

1. Decide which areas of the scene you want to be on Zone III in the final print (in this case, the model's hair).
2. Meter that area and make note of the exposure that the meter is recommending, in this case, f/11 at 1/30 of a second.
3. Stop down two stops from this recommended exposure to place the model's hair on Zone III. The corrected exposure would be f/22 at 1/30 of a second.

If you are using an in-camera light meter, the procedure would be a little different:

1. Set your in-camera meter to its manual mode.
2. Previsualize your Zone III area.
3. Get close enough to your subject so that this area fills the viewfinder.
4. Center the needle or dot and note the exposure that the camera's meter is recommending.
5. Stop down two stops from this recommended meter reading to place that area on Zone III.
6. Using this new exposure, step back and take the picture.

(See Chapter 7, page 85 for a discussion on overriding automatic built-in metering systems.)

Some people have difficulty believing that the Zone System is really that simple, or they have trouble "disobeying" their meters. If you think through this example, however, you will see how logical it is.

You now have a completely reliable way of using your light meter as a tool to give you the correct exposure according to your previsualization. If you were to previsualize a light wall as

Zone VII and were unconcerned about any shadows that might be in the picture, you would simply meter the wall and open up two whole stops from the meter's recommended exposure. Opening up one stop would place the wall on Zone VI.

Of course, for all of this to work properly, you must use the correct ASA for the film you are using. I will discuss this factor in detail in Chapter 7, "An Overview of the Zone System." The effects of reciprocity failure, filter factors, and bellows extension are covered in Appendix R.

The problem that most beginners have with this process is previsualization. Previsualizing is an act of aesthetic judgment that offers you a wide variety of choices. There are obviously a number of effective ways to interpret any given subject. While you are learning this process, I suggest that you stick to "normal" previsualizations of your subjects. Later, when you are sure that you can consistently produce realistic results, begin experimenting with alternative ways of seeing.

What's most important is to realize that the major advantage of the Zone System of exposure is that it's an intentional process that allows you to place specific subject tonal values wherever you want them to be on the zone scale.

Other problems that many of us have with previsualizing black-and-white photographs are the associations we have with certain colors. Most people judge a blue object to be darker than a red one, even if both objects are actually reflecting the same amount of light. A handy device for dealing with this problem is a panchromatic viewing filter. Looking through this brown-colored filter removes most of the color from the scene and reveals the inherent contrast as the black-and-white film will see it. A Kodak Wratten Filter Number 90 will give you approximately the same effect and is usually much less expensive.

Now that you understand how the Zone System applies to exposure, it's time to move on to the principles of Zone System Development.

Once again, because there is no development in the digital process, all the examples will be based on film. But we will discuss concepts that are useful for digital photographers to understand.

chapter **six**

Development

Placing an Important Shadow Area on Zone III guarantees that your negatives will be properly exposed, but that's only the first step toward creating a perfect negative. In this chapter, we will consider the effect this has on all of the other values of the scene you are photographing.

The two important questions are:

1. Where does the Important Highlight Area fall on the Zone Scale?
2. How does this affect your development time?

As we learned, the rule is: ***Develop for the Highlights.*** This means that the correct development time for a given negative depends on the amount of contrast in each scene you photograph.

At this point, photographers with 35mm cameras begin to wonder how each frame of a roll of film can be developed individually. The answer is that there is no practical way to do this, but there are many ways of adapting roll-film procedures to this rule. I will discuss these after covering the basic theory.

[**note**] To make these concepts more clear, I will be using handheld meter readings with EV numbers (or simply "meter numbers") in these examples (refer to Chapter 4, "The Zone"). (See the section "Measuring Subject Contrast with In-camera Meters" on page 62 for a detailed description of how these principles apply to those meters.)

Let's consider the effect of measuring the contrast of different subjects in terms of zones. Once again, imagine that the portrait in Figure 6.1 is an actual subject you intend to photograph.

The fence and dark foliage behind her were previsualized as Zone III and II; and the lighter parts of her slip were previsualized as Zone VII and VIII. Her skin should be Zone IV and V, and the shadows on her slip are seen as Zone VI.

FIGURE 6.1 Normal-contrast subject. Negative given Normal Development.

FIGURE 6.2 Spot-meter EV readings for the preceding figure.

Figure 6.2 indicates the spot-meter readings for the previsualized areas of the subject. The numbers indicated are the average meter readings of those areas.

Although for the sake of this example I have listed a number of different readings, it's very important to understand that, to measure the contrast of any subject, you always have to make **at least two readings**: one of the Important Shadow Area and one of the Important Highlight Area. In the real world, none of the other meter readings are strictly necessary, and this vastly simplifies the process of using the Zone System.

After you have previsualized your subject, the first step toward measuring its contrast is to place the Important Shadow Area on Zone III. Placing the foliage (meter number 6) on Zone III can be diagrammed as shown in Figure 6.3A.

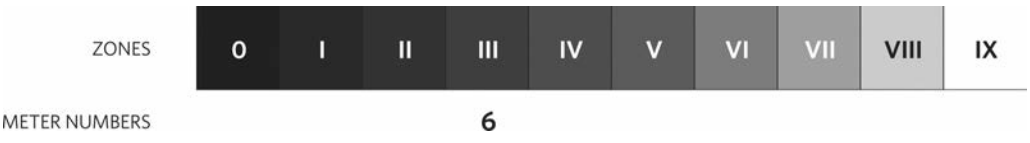

FIGURE 6.3A EV meter reading number 6 placed on Zone III.

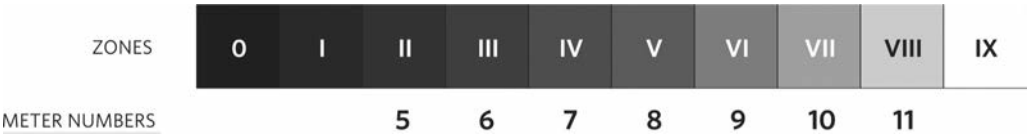

FIGURE 6.3B EV meter number 10 falls on Zone VII.

Maintaining the "one meter number for one zone" relationship, you can fill in the other EV meter readings for this scene under the appropriate zones as shown in Figure 6.3B.

The principle at work here is really very simple. After the selected subject value has been placed on a zone (in most cases, you will be placing the Important Shadow Area on Zone III), all the other subject values have to fall on the other zones of the scale. The specific zones on which the other EV meter readings fall will depend on how much lighter or darker they are than the placed value. In this way, you are actually **measuring the contrast of your subject in terms of zones**.

A good analogy for this process would be measuring a piece of fabric. Imagine that the cloth is five inches long (or five zones in this case). If you "place" one end of the fabric on the three-inch mark of a ruler, the other end of the cloth has to "fall" on the eight-inch mark (Figure 6.4).

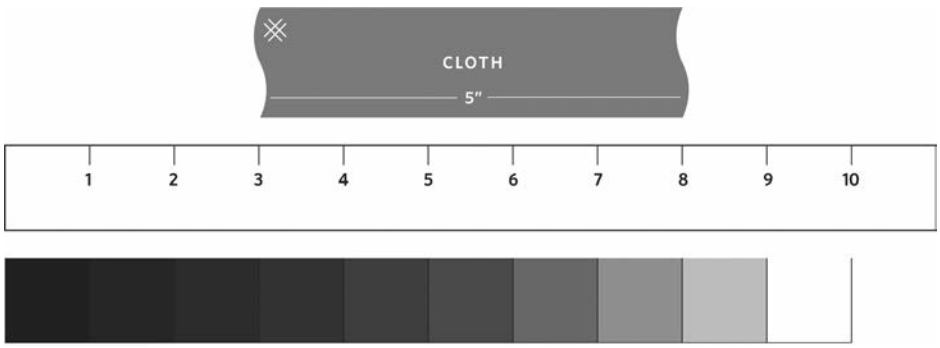

FIGURE 6.4 After one end is "Placed" the other end "Falls".

In this first example, we're using the Zone Scale to measure the portrait's range of contrast by seeing where the EV meter readings of the relevant subject areas fall. As you can see in Figure 6.3B, placing meter number 6 on Zone III means that meter number 5 has to fall on Zone II because the darkest foliage on the right is reflecting one-half as much light as the foliage on the left. EV meter number 7 has to fall on Zone IV because the subject's skin is twice as bright. We can now say that this scene has a range of fully textured contrast equal to five zones—from Zone III (meter number 6) to Zone VII (meter number 10). The other zones in this scene add depth and brilliance to the print, but the five textured zones between III and VII are most important for determining the proper exposure and development.

After you have placed EV meter number 6 on Zone III, meter number 8 will fall on Zone V. If you move the arrow on the meter's dial to that number, you will have all the correct exposures for this portrait.

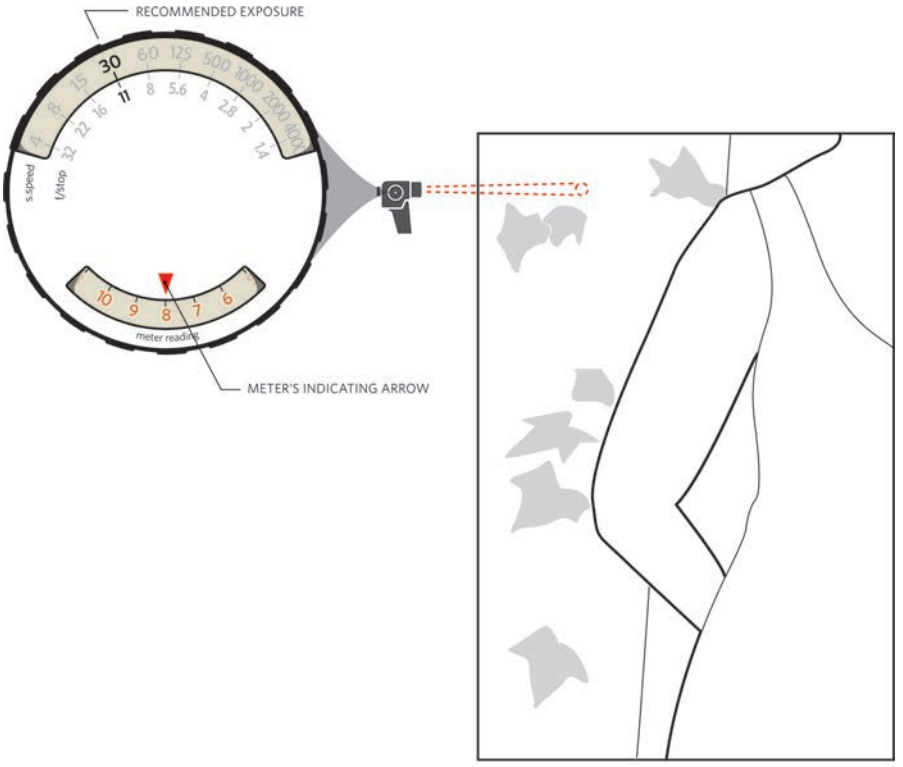

FIGURE 6.5 Placing meter number 6 on Zone III.

Notice that in this example the correct exposure is indicated as **1/30th at f/11.** Keep this reading in mind. I'll be referring to it in the next example.

[**note**] As you can see from this illustration there are other recommended exposures that are equivalent to this one.

Think this through: The meter's indicating arrow is always in the correct position when it is pointing to the number that you want to fall on Zone V. Your Zone III placement will **always be two meter numbers less** than this Zone V number. This suggests a simple method of operating your analog meter. After you determine what meter number you want to place on Zone III, simply **add 2** to that number and move the indicating arrow to the result (see Figure 6.5).

Because of the way digital light meters are designed, using a simple chart like the one on page 53 of the previous chapter may make more sense.

Now that we have used the Zone Scale to measure this scene's contrast, all that remains is to see how this compares with our previsualization.

Remember that we previsualized this portrait as follows: the lighter foliage on the left as Zone III and the slip on Zones VII and VIII.

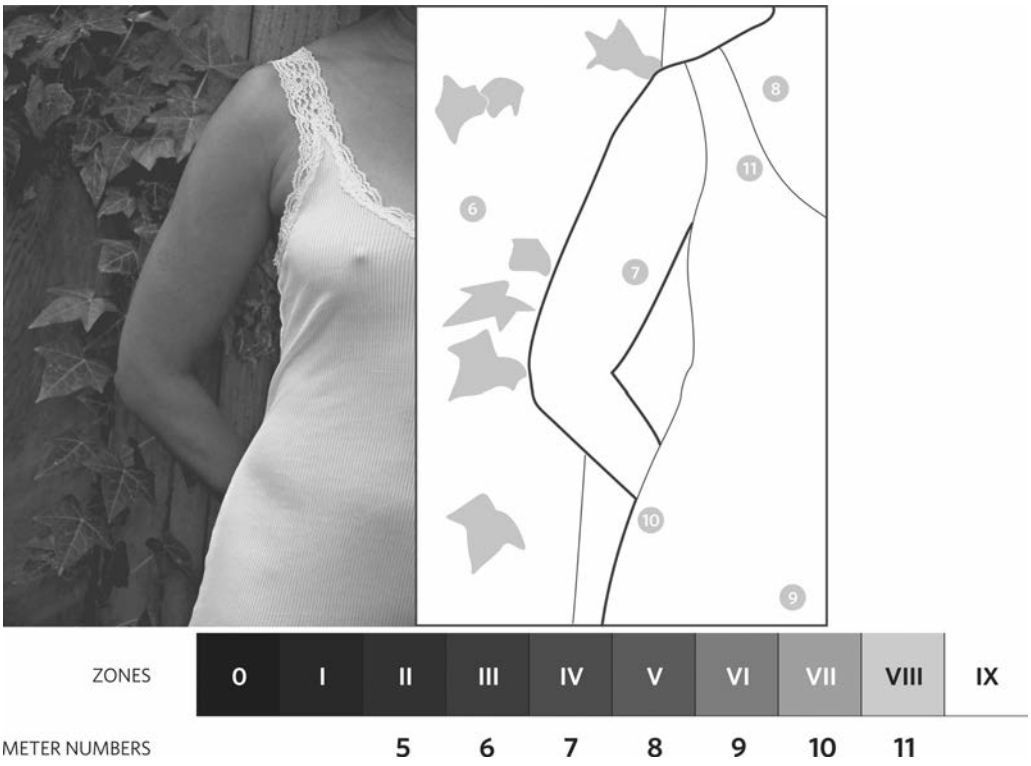

FIGURE 6.6 Zone Placements of the first figure in this chapter.

Figure 6.6 shows that all the key meter readings of this scene are falling on the appropriate zones.

We can now make a general statement that defines a precise method of determining how to properly develop your film:

> When a subject value previsualized as Zone VII falls on that zone after the Important Shadow Area has been placed on Zone III, the contrast of the scene can be considered Normal and the negative should receive Normal Development.

Remember that Normal Development is the standard development time for a given film and developer that will give you contrast in the negative equal to the contrast of the scene. (Refer to Chapter 3, "The Control of Negative Contrast.")

Because the contrast of this portrait is Normal (and because the placement of the shadow value is correct), Normal Development will result in a negative that will print well on a normal grade of paper, usually grade or filter 2. Of course, the effective Normal Development Time for your film and developer can be determined only by testing them under controlled conditions. Chapters 8, "Zone System Testing: Method 1," and 9, "Zone System Testing: Method 2," offer very simple methods of testing various films and developers.

[**note**] Keep in mind that by "Normal" contrast, I don't mean that all the subject's values must fall exactly on the previsualized zones. What I mean is that the overall contrast of the scene should match the normal limits of the film and paper and that all the other middle values of the subject will fall somewhere within the five zones of the textural scale. In other words, don't be surprised if the meter reading for the face in a portrait falls on Zone V 1/2 or VI 1/2. Even when you are working with properly exposed and developed negatives, you need to dodge and burn in selected areas of the print to add emphasis or to correct tonal imbalances. Fine printing will always be an art unto itself.

This notion of how a properly exposed photographic subject that has inherently normal contrast will result in a well-rendered print is a concept that applies as much to digital photography as to analog. The principles of determining the correct exposure and knowing how to measure subject contrast are, in this sense, universal to all forms of photographic practice.

Let's review what we have done so far:

1. First, meter the area that you have previsualized as the textured shadow area and place that meter reading on Zone III (see Figure 6.3A).
2. Next, you should note which meter number falls on Zone V and turn the meter's Zone V indicating arrow to that number to determine the correct exposure (see Figure 6.5).
3. If the meter number for the area of the subject you want to print as Zone VII falls on that zone, you should give the negative Normal Development (see Figure 6.6).

As we have seen, because of the way digital light meters display their EV meter readings, using a simple chart like the one illustrated in Figure 6.6 makes this process very simple to visualize and understand.

Measuring Subject Contrast with In-Camera Meters

The principles you have just learned apply as much to in-camera meters as any other type, but the preceding examples may have been confusing because in-camera meters don't use meter numbers like those used in my illustrations.

Instead of using EV numbers, an in-camera meter translates its readings of the Important Shadow and Highlight areas directly into recommended f/stop and shutter speed combinations. Let's briefly review how this works.

In-camera light meters have various ways of telling you that "this is the correct exposure." When they are set to any of their automatic modes, they simply read out a given combination of aperture and shutter speed.

When they are in the meter's manual mode, you have to change your aperture or shutter speed until your electronic display is centered.

For example, Figure 6.7A is an example of a manual in-camera meter displaying an exposure of 1/30 at f/5.6 that is one stop overexposed. Figure 6.7B is the way the meter would display the "correct" exposure after you changed the aperture from f/5.6 to f/8.

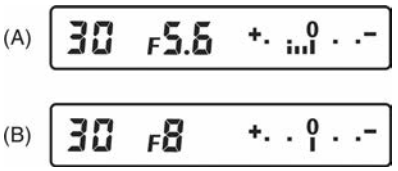

FIGURE 6.7 In-camera manual mode meter readings of overexposure and correct exposure.

As we learned in the previous chapter, automatic or centered manual readings are exposures that will cause what the meter is seeing to print as Zone V.

The important point to remember is that when the meter is reading something that you want to print as Zone III, the meter's recommended exposure would be two full stops too light! Conversely, if the meter is pointing to something you want to be Zone VII, its recommended Zone V exposure would be two stops too dark. This translates into a reliable way to use in-camera meters to measure the contrast of any subject.

To make the steps in this process more clear, let's use a Zone Metering Form, as illustrated in Figure 6.8, to organize readings. As you will see, a form like this one is helpful not only for photographers using in-camera meters, but also for those with digital meters and studio photographers working with flash meters. See Appendix T for a blank version of this form that you can copy for this purpose.

As I mentioned previously, to measure the contrast of any scene, you have to make at least **two meter readings**: one of the Important Shadow and another of the Important Highlight.

To simplify the process of comparing these two readings, think of either your shutter speed or your aperture as the **Reference Reading** that will remain the same from one reading to the other. I normally use the shutter speed as my fixed Reference Reading and apertures as **Measurement Readings** that change, as you will see in the following example.

[**note**] Conceptually this process would work just as well if you used an aperture as the reference reading and whole shutter speeds as your measurement readings but, if you plan on using the zone system for studio photographic work, as described in Chapter 11, you will see that there are very good reasons for using the method I'm suggesting.

Looking again at the portrait in Figure 6.1, here is how you would use the Zone System to measure the contrast and determine the proper exposure using an in-camera meter.

Normal-contrast subject. Negative given Normal Development.

[**note**] Either manual or automatic modes can be used for this process, but remember to adjust your readings so that the shutter speed (in this case 1/30) remains the same. Also note that this is roughly the same procedure you would use with a smartphone light metering app.

[Step 1]

Get close enough to fill the frame of your camera with the Important Shadow Area (previsualized in this case as Zone III).

Take a careful meter reading of that area and make note of the meter's recommended exposure. In this example, the meter reading is 1/30th at f/5.6.

[**note**] The Normal Plus and Minus designations I've added to the preceding Zone Metering Form are intended to give you guidelines for determining your development times, but remember that these will apply only when your goal is to use Zone VII as your Important Highlight.

[Step 2]

In this example I'll use the shutter speed as my Reference Reading, so I entered 1/30 in the box provided for that purpose.

[Step 3]

This next step is very important to understand!

Because f/5.6 is the Measurement Reading I got for the area previsualized as Zone III, I entered 5.6 in the Zone III box in the chart.

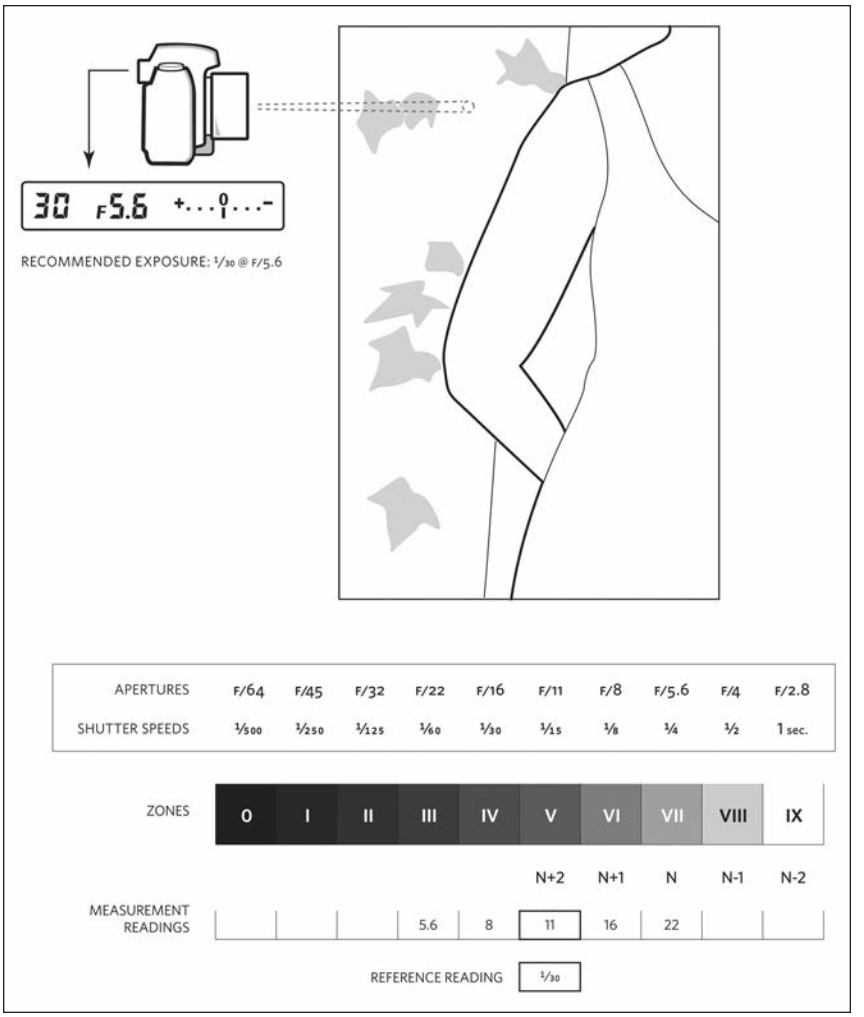
30 F5.6
RECOMMENDED EXPOSURE: 1/30 @ F/5.6
APERTURES F/64 F/45 F/32 F/22 F/16 F/11 F/8 F/5.6 F/4 F/2.8
SHUTTER SPEEDS 1/500 1/250 1/125 1/60 1/30 1/15 1/8 1/4 1/2 1 sec.
ZONES 0 I II III IV V VI VII VIII IX
N+2 N+1 N N-1 N-2
MEASUREMENT READINGS 5.6 8 11 16 22
REFERENCE READING 1/30

FIGURE 6.8 Zone System Metering Form. In-camera metering the Zone III area. Meter reading: 1/30 at f/5.6.

[Step 4]

I then entered all the corresponding full aperture readings under the zones where they fall.

The reason the apertures are entered in the order as illustrated is that the light meter recommends smaller and smaller apertures when it records brighter and brighter subject values. As you learned in the previous chapter, the reason is that the meter is attempting to render those increasingly light subject values as Zone V (middle gray).

[Step 5]

The next step is to take a careful meter reading of the Important Highlight Area (previsualized as Zone VII) using the same shutter speed as the previous reading. In Figure 6.9, the reading is 1/30 sec at f/22.

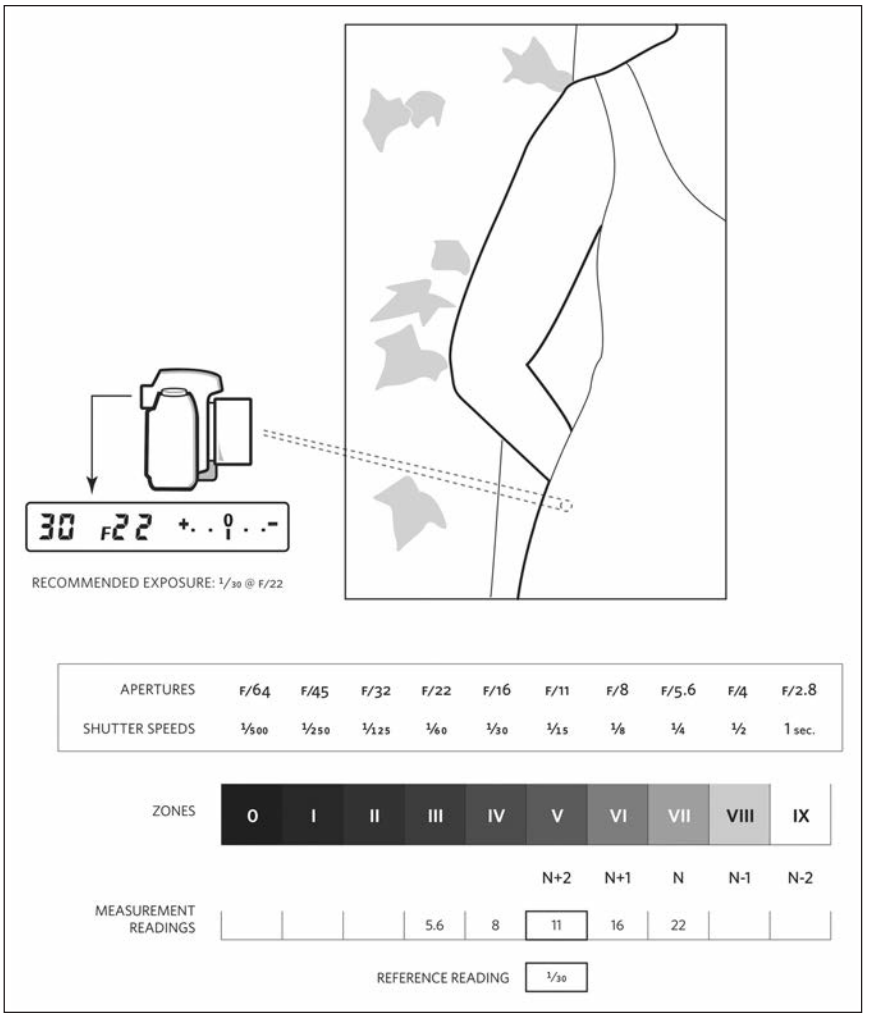
30 F22
RECOMMENDED EXPOSURE: 1/30 @ F/22
APERTURES F/64 F/45 F/32 F/22 F/16 F/11 F/8 F/5.6 F/4 F/2.8
SHUTTER SPEEDS 1/500 1/250 1/125 1/60 1/30 1/15 1/8 1/4 1/2 1 sec.
ZONES 0 I II III IV V VI VII VIII IX
N+2 N+1 N N-1 N-2
MEASUREMENT READINGS 5.6 8 11 16 22
REFERENCE READING 1/30

FIGURE 6.9 In-camera metering the Zone VII area. Meter reading: 1/30 at f/22.

An important point to notice is that these charts show that for both the shadow and the highlight measurements, I centered the manual meter readings so that the meter was giving me a Zone V exposure for both of these areas: 1/30 at f5.6 for the shadow area and 1/30 at f/22 for the highlight.

With the meter adjusted so that the shutter speeds were the same (1/30), what these two readings show is the difference in brightness between these two areas, using f/stops as my measurement scale.

Consider this process very carefully. Analyzing our chart after it has been completed in this way indicates a number of very important issues. First, notice that the aperture that falls under Zone V is f/11. As we saw in the previous example, **this is the correct exposure for this subject**. We would have gotten exactly the same result if we had simply measured the Important Shadow Area and stopped down two stops from 1/30th at f/5.6.

The second thing to notice is that the Measurement Reading of f/22 that we got for the Important Highlight Area is falling under the Zone VII section of the chart. Because this matches our previsualization of this subject, we can once again say that this scene has normal contrast and that we should give the film Normal Development.

Take the time to carefully review these steps until this process is clear to you.

With a digital spot meter, you could use a Zone System form like this one in a very similar way. The difference would be that, instead of entering apertures and shutter speeds, you could simply enter the meter's EV readings for the shadow and highlight areas, and your form might end up looking like the one here.

The correct exposure would be two stops less that the meter's Zone V recommendation for the Important Shadow reading.

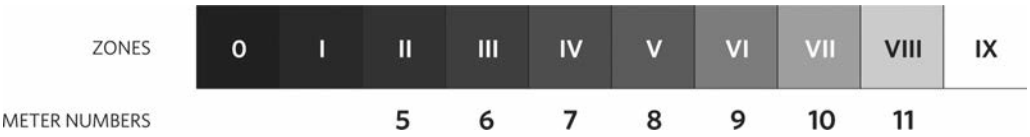

FIGURE 6.10 Digital spot-meter EV readings on the Zone System form.

In this case, if you got EV number 6 for the Important Shadow area and 10 for the Highlight, your development recommendation would again be Normal.

Normal Plus Development

Of course, in real life, things seldom work out as nicely as the previous example. Very often you will find yourself having to deal with subjects where the contrast is either too great or too flat to print easily on your favorite grade of paper.

[**note**] In these next two examples, I will use analog meter illustrations to make the process more clear. If you were using either a digital spot meter or an in-camera meter, you would follow the instructions outlined previously.

In this next example, the problem is making a printable negative from a scene that has *too little contrast*. The photograph in Figure 6.11 was taken on a very gray and overcast day. The print is dull and lifeless because the negative was given Normal Development and printed on a Normal grade of paper. Remember that, by definition, Normal Development results in negative contrast that is the same as your subject contrast.

In this case, the model's hair and shawl were previsualized as Zone III, her face as Zone VI, and her shirt as Zone VII. Figure 6.12 shows the EV meter readings for these areas of the portrait.

FIGURE 6.11 Low-contrast subject. Negative given Normal Development.

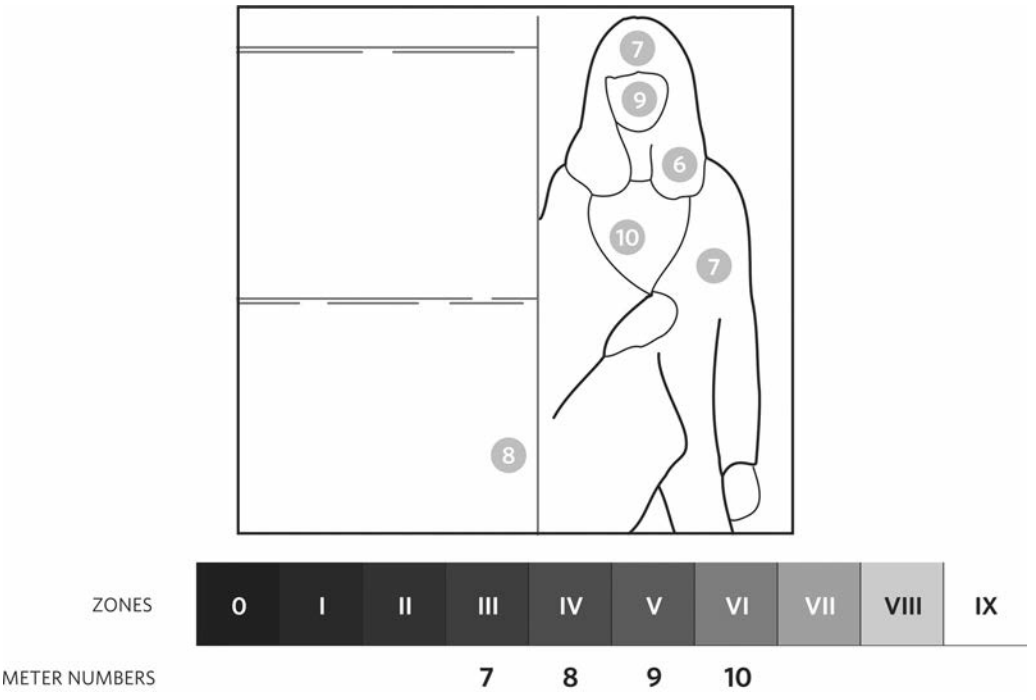

FIGURE 6.12 Spot-meter readings and zone placements of the previous figure.

FIGURE 6.13 Low-contrast subject. Negative given N + 1 Development.

When you place the Important Shadow Areas on Zone III (in this case, both her hair and the shawl read meter number 7), notice that the meter reading for her face (9) falls on Zone V, and the reading for her shirt (10) falls on Zone VI. As you can see, all the Important Highlight Areas of this subject are falling **one zone below** where you want them to be according to our previsualization. **The remedy is to expand the contrast of the negative with increased film development.**

As always, you can determine the correct exposure by turning the meter's indicating arrow to the number that falls on Zone V—in this case, EV number 9.

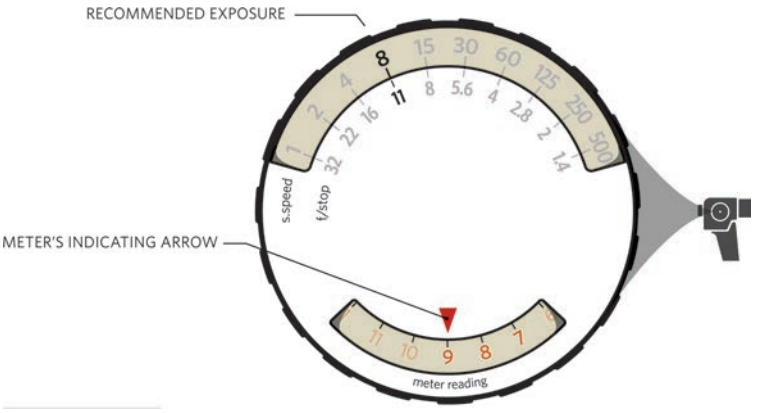

FIGURE 6.14 Zone III placement of EV number 7.

To compensate for the lack of contrast in this subject, you must increase the development time of the negative enough to raise a Zone VI negative density to Zone VII and a Zone VII density to Zone VIII. This increase is called **Normal Development Plus One zone**, or **N + 1**. Remember that increasing the development time does not affect the shadow densities nearly as much as it does the highlights (refer to Chapter 3).

By systematically increasing the highlight densities by one zone, you can produce a negative that has properly exposed shadows and more contrast than the original scene. The resulting print matches our previsualization and has a much better sense of light.

Figures 6.15 and 6.16 illustrate the effects of N + 1 and N + 2 Development, respectively.

The lines labeled "Print Zones" represent the zones of the subject as you previsualize them in the final print. The lines labeled "Subject Zones" represent the contrast of flat subjects measured in zones.

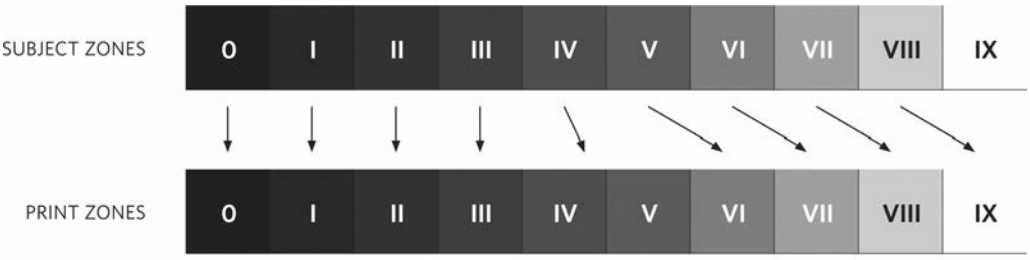

FIGURE 6.15 The effect of Normal Plus One (N + 1) Development.

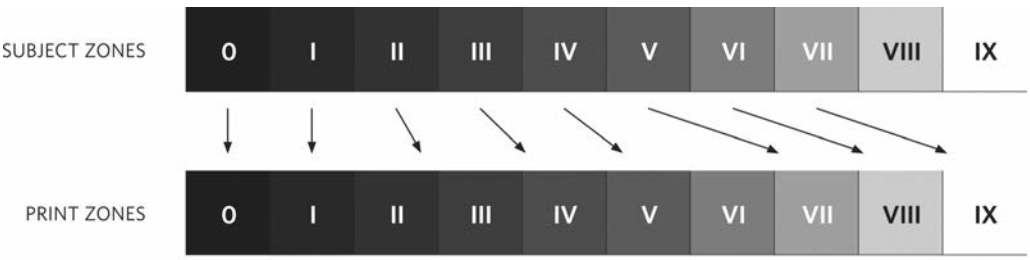

FIGURE 6.16 The effect of Normal Plus Two (N + 2) Development.

Notice that when a negative is given N + 1 Development, Zones VI, VII, and VIII will increase in density by **one full zone**. The zones that are below Zone V increase much less. Zone IV increases by only one-half of a zone, and Zone III *hardly moves at all*.

For this reason, Zone V can effectively be considered the borderline between the zones that will increase *proportionately* with longer development and those that won't. Because the zones below Zone V increase in density at a much slower rate, increasing the development time of the negative increases its contrast. You can determine the exact times for negative expansions by doing tests that are outlined in Chapters 8 and 9.

To summarize, the way to produce usable negatives from subjects with very little contrast is to *expose for the shadows* and then *increase* the negative's development time enough to raise the highlight densities to the proper previsualized zone.

[**note**] Extreme Normal Plus Development will result in grainier negatives, which could be a problem for those working with roll-film cameras. An alternative method for increasing the contrast of 35mm negatives without added grain would be to intensify your film in selenium toner. For more information about this process, refer to Appendix K.

A good question to ask at this point would be: Why not simply place the shadow reading in this example (meter #7) on Zone IV instead of Zone III? Your placement would then look like that in Figure 6.17.

FIGURE 6.17 EV number 7 placed on Zone IV.

The highlight reading is now falling on the proper zone, but notice that you have effectively overexposed the negative without increasing its contrast. The result would be a print with gray, flat shadow areas.

Normal Minus Development

The problem in this case is the opposite of the one in the previous example. Here, the combination of bright sunlight and white surfaces causes this to be a very contrasty photographic subject. The goal is to show detail in the shadow areas (in this case, the model's shawl) while maintaining the subtle texture and brilliance of the highlights.

If you were to place the shadow readings on Zone III and give the film Normal Development, the result would be a negative with overly dense highlights. In the print, these nearly opaque densities will appear as empty, glaring whites with no tonal separation or surface detail (see Figure 6.18).

[**note**] This is a very common problem in the digital world where the limited dynamic range of some camera sensors results in clipped highlights.

Notice that the shadow areas are properly rendered, indicating that the exposure is correct but the highlights are washed out. A reduction in the negative's development time is required, but the question is how much?

The model's shawl is previsualized as Zone III, her face as Zone VI, the shadows on the wall as Zone V, the sunlit wall as Zone VII, and her white jacket as Zone VIII. Figure 6.19 indicates the spot-meter readings for these areas.

FIGURE 6.18 High-contrast subject.
Negative given Normal Development.

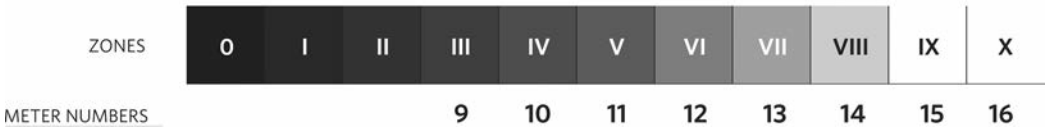

FIGURE 6.19 Spot-meter readings and zone placement of the previous figure.

FIGURE 6.20 High-contrast subject. Negative given N – 1 Development.

Don't be confused by the sudden appearance of Zone X. For the first time, we are using the Zone Scale to measure the contrast of a very contrasty scene. The extra zone space simply gives us a place to record where this very high reading falls.

As you can see, when EV number 9 is placed on Zone III, all the highlights fall **one zone higher** than our previsualization.

The correct exposure is determined by turning the meter's arrow to EV 11 (see Figure 6.21).

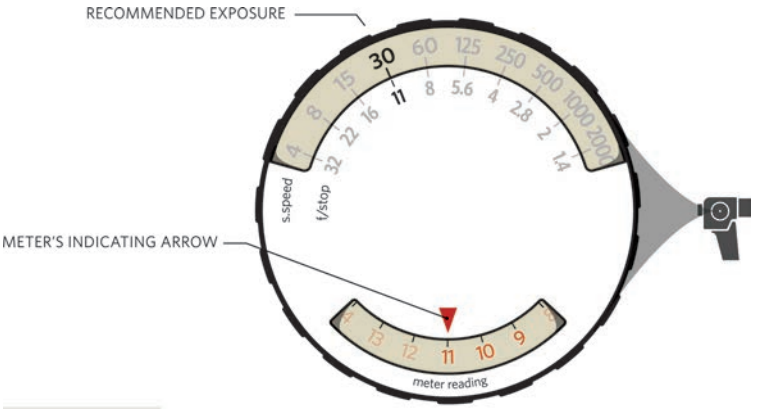

FIGURE 6.21 Zone III placement of EV number 9.

The next step is to give the film less than Normal Development to reduce the density of the negative's highlights. Because the highlights of this portrait are falling one zone too high, the correct development time for this negative would be the **Normal Minus One zone,** or **N – 1** (Figure 6.22). The resulting print has well-detailed shadows and textured, luminous highlights.

The effects of N – 1 and N – 2 Development are illustrated in Figures 6.22 and 6.23.

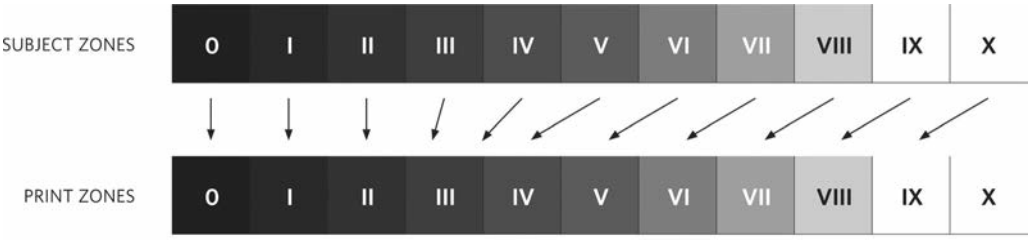

FIGURE 6.22 The effect of Normal Minus One (N – 1) Development.

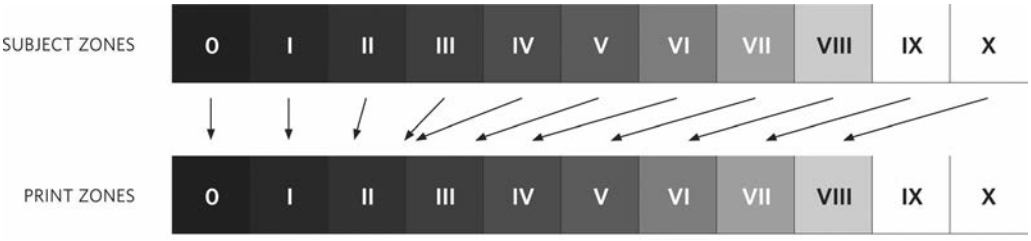

FIGURE 6.23 The effect of Normal Minus Two (N – 2) Development.

Notice that with N – 1 Development, a Zone VIII negative density is reduced to a density equivalent to Zone VII, while Zone IV only decreases to Zone III 3/4. Because the higher zones decrease in density much more than the Zones below Zone V, **shortening the development time has the effect of reducing the overall contrast of the negative**. Again, you can determine the exact times for negative contractions by testing your film and developer. It is important to note that when the film is given less than N – 2 Development, there is a noticeable loss of negative density in the lower zones. The remedy for this problem is simply to remember to place your Textured Shadow reading on Zone IV instead of Zone III when the contrast of the scene is extremely high. For further discussion of the effects of extreme Expansion and Contraction, refer to Appendix K.

chapter **seven**

An Overview of the Zone System

This chapter briefly summarizes the Zone System method of exposure and development and answers a number of questions students usually ask at this point in the process.

What you have learned is that when the subject being photographed is flat or has too much contrast, you need to control the contrast of your negatives.

Here are the general steps for producing consistently printable negatives.

[Step 1]

Previsualize your subject in terms of the finished print. This means that you should mentally assign a zone to the important textured shadow and highlight areas of the subject.

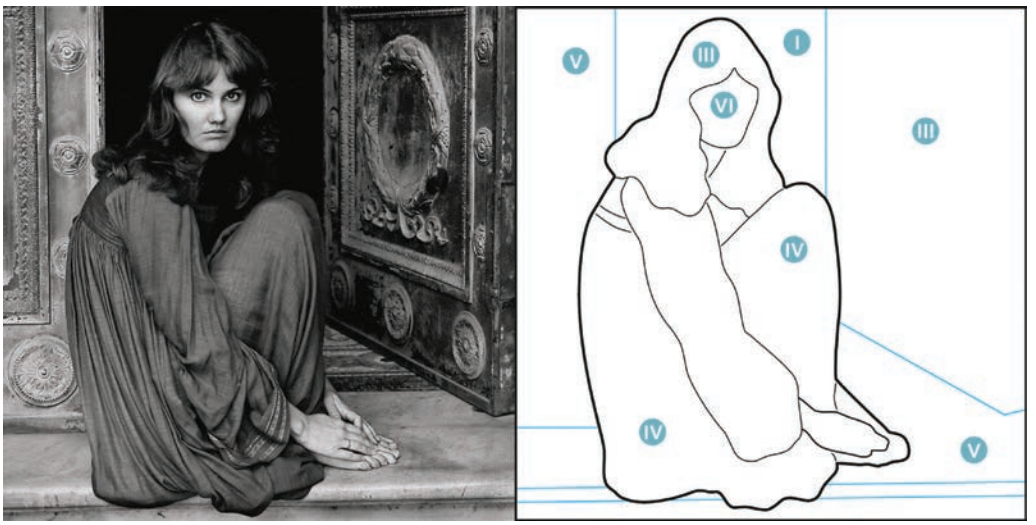

FIGURE 7.1 Previsualization.

To choose the correct exposure, you need to decide which parts of the picture you want to be Zone III. Zone III is the zone for the area of the subject that you want to print as a fully textured shadow value.

[Step 2]

Determine the correct exposure by carefully metering the Important Shadow Area and placing it on Zone III. You do this by stopping down two full stops or shutter speeds from the meter's recommended Zone V exposure for that area.

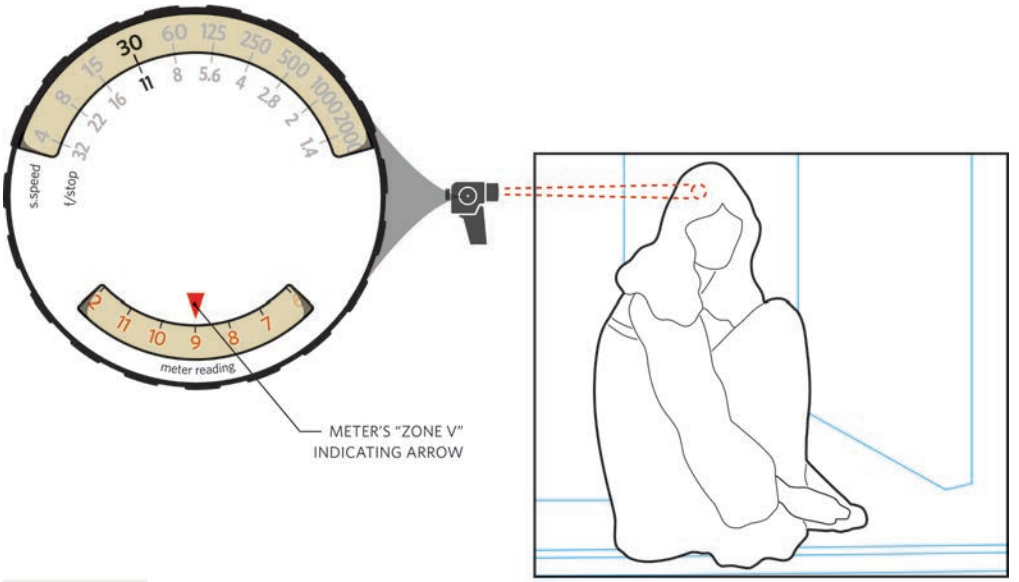

FIGURE 7.2 Placing meter number 7 on Zone III; the correct exposure for Figure 7.1 is f/11 at 1/30 of a second.

Keep in mind that although an analog spot-meter dial is being used to illustrate this example, the same process would apply regardless of the kind of meter you are using. See Appendix F for instructions on how to use digital spot meters for Zone System exposures.

To determine the correct development time for the negative, you need to identify the Important Highlight Area of the subject. In most cases, this will be Zone VII, which is the brightest zone with full texture and detail. In the case of the subject in the first figure, the Important Highlight would be her face, which is Zone VI.

[Step 3]

Measure the subject's range of contrast in terms of zones by plotting the meter readings of the scene against a Zone Scale.

The specific method you use for this step depends on the type of light meter you are using.

With handheld spot meters that read with EV numbers, you would write the EV reading of the Textured Shadow Area on the form under Zone III and then apply the rule: One meter number equals one zone.

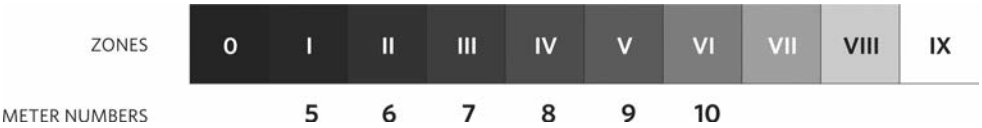

FIGURE 7.3 Placing the textured shadow reading on Zone III.

With digital or in-camera or smartphone light meters, you learned the two-step process that uses a Zone Metering Form:

- The first step is to enter into its designated box the Reference Reading that will not change between your Important Shadow and Highlight readings.
- For the second step, you meter the Important Shadow Area and write the Measurement Reading under the Zone III section of the chart. All the other Measurement Aperture Readings fall on corresponding zones on the chart.

Remember that the Measurement aperture reading that falls on Zone V, together with the Reference Shutter speed, is the correct exposure for this image.

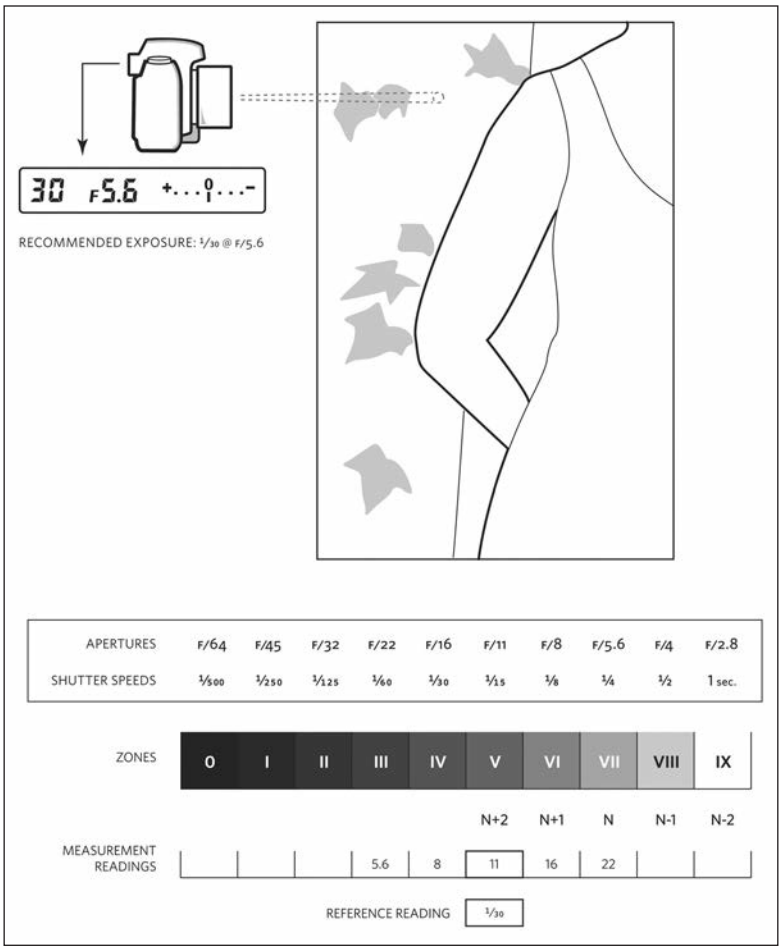

FIGURE 7.4 Zone Metering Form of in-camera readings.

[Step 4]

Determine the correct development time for the negative by carefully metering the areas that you have previsualized as Zone VII (or Zone VIII, depending on the subject matter). If this meter reading falls on the proper zone after the textured shadow has been placed on Zone III, give the film **Normal Development**.

[Step 5]

If the meter reading for the Important Highlight Area falls above or below the previsualized zone, increase or decrease the film's development time according to how many zones away from the previsualized zone it falls.

For example, if the Important Highlight Area falls one zone above the previsualized zone on the Zone Scale, the recommended development time would be Normal Minus One zone (N – 1).

You should write these numbers directly on the film holder or cassette to avoid confusion.

Expose for the Shadows and Develop for the Highlights

The Zone System method of negative contrast control is as simple as that. When you appreciate the importance of properly exposing and developing your negatives, it simply becomes a matter of working with the system long enough for the principles to become familiar. Your first attempts at applying the Zone System to your photography might make you very aware of other weaknesses in your technique. No system, however logical or straightforward, can compensate for faulty equipment or carelessness. But, if you are persistent, you will eventually work out all the bugs and develop your own set of shortcuts. At that point, your work will begin to flow smoothly.

One of the first steps in this process is losing your anxiety about making a mistake. This is why the test outlined in the next chapter is so important. After you produce your first successful print with the Zone System, the mystery will disappear.

One of the misconceptions about the Zone System is that it will make photographic printing routine. The goal is not to make photography an exact science, but rather to allow photographers to concentrate on the parts of the process that require intuition and imagination. What you will find is that a little bit of understanding and control will go a long way toward solving your technical problems. After the negative is made, the issue becomes how to best interpret it through creative printing.

When you begin using the Zone System, you may encounter some of the following problems. First, you may have trouble previsualizing the subject in terms of zones. Getting used to any new system takes awhile, but before long you will find that it comes naturally. Keep in mind that for the purpose of determining the correct exposure, the only question you need to answer is "Where is the area that I want to be Zone III?" Look for an area of the subject that would spoil your photograph if it were too dark in the finished print. Most likely, this is the area you want to place on Zone III. Again, it is useful to spend time studying other photographers' work to help you develop a sense of your own aesthetic.

The second important question you need to answer for the correct development time is "Where is the Zone VII area of this subject?" Practice will make this easier, but a good guideline is, if the area in question is light colored and textured, call it Zone VII.

You can easily overdo trying to pinpoint specific zones. At first, it may be difficult to "see" Zone VII when the contrast of the subject is very flat. The lack of an obvious light value in the subject could make previsualizing Zone VII seem illogical. It could also be that you might not want a Zone VII in that particular image. In this case, consider Zone VI to be the Important Highlight zone for this image and develop the film accordingly. This was true in the example of Figure 7.1.

This advice also applies to Zone III. If you decide that Zone II is the appropriate zone for the Important Shadow Area of your subject, place your meter reading on Zone II and start from there. (The only danger with this approach is that you cannot change your mind after taking the picture and give that area more exposure later.) The purpose of the Zone System is to give you creative control, not to lock you into hard and fast aesthetic limitations. Whenever you are in doubt about how to proceed with a given image, make a decision and pay careful attention to your results. Be sure to keep careful records when you are unsure. In general, you can count on the obvious associations I have mentioned before. Light clothing, concrete, and white objects in the shade are usually Zone VII. Dark foliage, dark clothing, and brown hair are commonly Zone III. Paper and white objects in sunlight are generally Zone VIII.

Zone System beginners often become confused about which way to turn the meter dial to place a shadow value on Zone III. At first, it is easy to turn the dial the wrong way and drastically overexpose the film. I believe that this is by far the most common mistake students make when they first begin learning the system. The key is to remember that you are trying to make the Zone III area of the subject darker than the meter is telling you to. The reason is that Zone III is **darker** than Zone V.

As you turn the dial, watch to see whether the exposures are becoming longer or shorter. If, for example, turning the dial to the right decreases the exposure, memorize that direction for future use.

Classic analog spot meters like the Pentax Spotmeter V have enough room adjacent to the meter numbers to attach a small Zone Scale like the one illustrated in Figure 7.5.

Self-adhesive decals of this kind were once available from Fred Picker's Zone VI Studios. These days, I suggest that you simply create one for yourself if this is possible on your meter. Make sure you line up the scale with the Zone V section over the meter's indicating arrow. A scale like this will

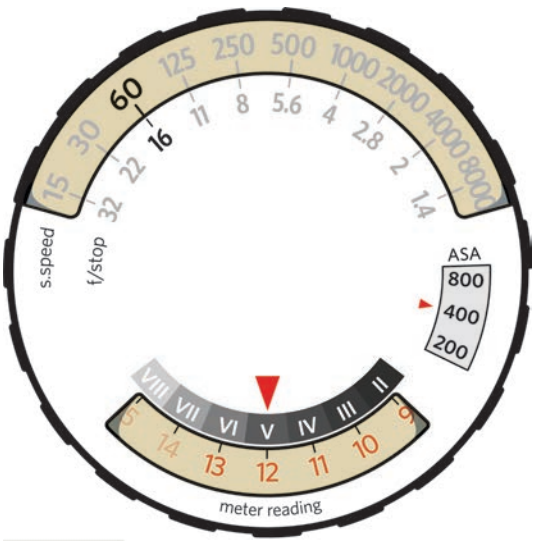

FIGURE 7.5 How to place meter number 10 on Zone III using a Zone-Scale decal.

make zone placement and contrast measurement ridiculously easy. For example, when you want to place a given meter number on Zone III, all you need to do is turn the dial until that number is under the Zone III section of the scale. You can now read the correct exposures and the relative positions of all the other meter numbers directly from the dial. A visual aid like this makes it very easy to think through the placement and exposures you will want to use. Actually seeing the meter readings falling on the rest of the scale will make the process much more concrete.

Another common problem is faulty equipment. After carefully metering, exposing, and developing an image, you may discover that it is ruined because of a seriously inaccurate light meter or shutter. You are less likely to notice a problem like this when you aren't sure of what you are doing in the first place. It is a good idea to take your meter and shutters to a good camera repair store to have them checked before you begin trying to improve your technique.

Zone System Frequently Asked Questions

Let's consider some of the questions commonly asked about the Zone System.

Q: The procedure you have described is fine for situations in which there is plenty of time to take careful readings. What should I do if I have to shoot quickly?

A: This and the following question are natural concerns for roll-film photographers who don't have time for detailed previsualizations and numerous meter readings. However, it may now be clear that the principles we have learned are just as important for fast-shooting documentary photographers as they are for those shooting landscapes. One answer would be to reduce the process down to its bare essentials and work from there. In all the previous examples, I have included meter readings for all the important areas of the subject to make the process more clear. Practically speaking, there are only two meter readings that you absolutely must make. You need one reading of the Important Shadow Area to calculate the exposure (at this point, you can take the picture) and one reading of the Important Highlight Area to determine the proper development time. You will need to write this down so you will know how to process the film. Unless the light changes while you are shooting, there is no need to recalculate the exposure. Try to simplify your methods as much as possible. Experienced documentary photographers or photojournalists will often determine what the proper exposure and development characteristics are for a given situation before they expose their first frame. Eventually, you will instinctively know, for example, that you are in an N – 1 setting, and at that point, you would simply determine the correct exposure and make sure that you keep track of all the rolls you shoot in that situation.

Q: I can understand how the Zone System would be easy to use with a view camera, where each frame is developed individually, but how can I apply these methods to roll-film?

A: The process for using in-camera light meters along with the Zone Metering Form that I outlined in Chapter 6, "Development," makes applying the Zone System to roll-film cameras relatively simple. But now that you are aware of the relationship between the contrast of your

subject and the negative's development time, you will find yourself automatically adapting your shooting methods to ensure that the roll for each subject is developed properly. The problem most photographers have is that they are unaware that this connection exists at all. In most situations, this won't be a problem. For example, if you are shooting outdoors on a clear day, you will find that the contrast won't change very much. Take one set of readings, shoot the whole roll, and indicate on the cassette how it should be developed. If you are in the middle of a roll and you find that the contrast is changing, either because you have to change locations or because of a change in the incident light, you have two choices: You can either quickly shoot the rest of the roll and start another, or you can take another set of readings and make note of how much difference there is between the contrast of the two scenes. If there is less than one stop's worth of difference in contrast (that is, if the first scene required Normal Development and the second situation calls for N + 1), don't worry about it. Just recalculate the exposure for the second scene and count on higher or lower grades of paper to compensate for the difference. If the difference is much greater than this and you can't change rolls, you may have to sacrifice the contrast of one scene or the other when you develop the roll or split the difference in development (that is, if one situation required N – 1 and the other N + 1, you should develop the roll using Normal Development). A good guideline for roll-film photographers is when in doubt, overexpose and underdevelop. It is much easier to compensate through careful printing for a slightly flat negative than for one that is too contrasty. Also, the reduced development time will minimize grain.

You will find that ingenuity and compromises are sometimes necessary when using roll-film cameras in certain situations. If you are using a camera with interchangeable backs, such as an analog Hasselblad, you have the option of labeling one back Normal, another N + 1, and so on. This will allow you to switch backs as the situation demands. Eventually, you will find that your awareness of the importance of subject contrast will make you very sensitive to changes in the light. Roll-film cameras are designed to make bracketing very simple. If you take advantage of this and pay attention to how the contrast changes from one moment to another, you will gradually develop instincts that will make adapting to this situation much less of a problem. Another alternative is self-rolling very short rolls of film with the intention of shooting one roll per subject. If this is done carefully (dust in the bulk loader's gate can be a serious problem), it will work and save you money. In the long run, it is probably better to "waste" the extra frames on a normal roll of film. (I put the word "waste" in quotation marks because often your best shots will be on those extra frames.)

Q: Can the Zone System be used with color film?

A: In general, the answer is yes, and in many ways, certain inherent characteristics and limitations of color films make the Zone System an even more important tool.

On the one hand, the rules of exposure apply as much to color film as they do to black-and-white. On the other hand, color materials present you with special problems you should be aware of to avoid some typical problems.

First, the range of subject contrast that can be recorded on color reversal films (otherwise known as chrome, transparency, positive, or slide films) is relatively narrow when compared with color negative or black-and-white films.

The effective range of detail in a properly exposed and processed color negative can be between Zones II and VIII. With chrome films, the range is between Zones III and VII. Slide films are very intolerant of exposure errors because they have relatively limited exposure latitude.

If your exposure is more than one-third of a stop over the correct placement of Zone VII, the whole image will be too light. This means that in general you will get better results using color-slide film in situations in which the contrast is not too great—indoors with flash or outdoors on slightly overcast days, for example. The predictability, accuracy, and reliability of the Zone System of exposure can be of great advantage when you are shooting color films.

The second problem is that if color film is given more or less development than the amount predetermined by the manufacturer, you run the risk of getting inaccurate color in the resulting slide or negative. Overdevelopment causes the images to look warmer (more red); underdevelopment results in cooler pictures (more blue). This shift in color balance can be corrected to some degree when color negatives are printed, but because the positive is the final product with chrome films, it does not allow for any adjustments after the slide has been processed.

Underdevelopment also causes the black areas of color slides or prints from color negatives to be "incomplete," meaning that the black areas will be rendered as a muddy dark gray with a noticeable colorcast. One result of this effect is that there is no simple way to control the contrast of color films without affecting the color rendition. This means that you may have to adapt the way you expose color film when subject contrast is greater than the effective range of the material you are using.

For example, with chrome films, if you are shooting a very contrasty subject—a snow scene with dark foliage, for example—you may have to expose for the highlights and allow the shadows to fall where they will. This could mean metering the snow and placing the reading on Zone VI or VII for color negatives or Zone VI for color-slide films. The foliage will probably appear as relatively dark silhouettes, but the overall impression of the image should be acceptable. If possible, you could use a reflector and electronic flash to add more light to the darker areas.

Color negative films are self-masking, which means that the density of the highlight areas cannot increase beyond certain preset limits as they develop. This essentially allows the shadows to "catch up," giving you relatively more detailed dark areas without blocked-up whites. As a result, color negative films can be overexposed by as much as three stops and underexposed by one-half stop from the manufacturer's ISO, and the negatives will still be printable.

Color-slide films don't have these advantages. Because of this and their more narrow contrast range, color transparency films require more careful control. One major advantage of understanding and using the Zone System is that it gives you a reliable way of measuring subject contrast and exposing accordingly.

In commercial studio and location photography where film is still being used, it is often necessary to use longer or shorter development times to make small, precise corrections of the overall density and contrast of your chrome. Contrast and exposure manipulation is done with

extra lights or reflecting fill-cards. If more corrections are needed, many of the remaining better color labs will custom process chrome films if you know the practical limits of the materials and how to explain what you want to the technicians.

To color labs, pushing and pulling film means, respectively, increasing and decreasing the development time. Instead of "zones," the labs are more accustomed to speaking in terms of "stops." Thus, "pull this film one stop" means "please reduce the development time of this roll by enough to give me one zone's worth of Contraction."

The following are some guidelines for push and pull processing of chrome and color negative films:

- The higher the ISO of a given chrome film, the better the film pushes and the more it responds to plus development while maintaining acceptable color balance.
- The lower the ISO of a given chrome film, the more it responds to pulling while maintaining color balance.
- All chrome films are developed in E6 chemistry, and the maximum range of pushing is plus three stops, and the most they can be pulled is to minus one-and-a-half stops.
- All color negative films are developed in C-41 chemistry and are best if pushed to no more than two stops or limited to a one-stop pull.

Because of the color shift problems described here, Kodak and Fuji do not recommend push or pull processing for the "Pro" versions of their films.

Q: What problems will I encounter if I can't use a spot meter?

A: As you have seen in the previous chapters, a spot meter's ability to read small, isolated areas from a distance makes it the perfect tool for using the Zone System. You can, however, achieve reliable results from any meter if you know how to use it properly.

A wide-angle or smartphone light meter will give you an accurate reading of any area if you get close enough to the metered area and are careful not to include unwanted objects in the meter's field of view.

A built-in meter, aside from being wide-angle, has two other features you should be aware of. The first is that built-in meters are very often "center-weighted," which means that they are designed to be more sensitive in the center of the frame than at the edges. Second, built-in meters are sometimes calibrated to place their meter readings on Zone VI instead of Zone V. The reason for these idiosyncrasies is that the camera manufacturer is making two assumptions. First, it is assuming that you are going to put your friends or relatives in the center of the frame. Second, the company is assuming that the subjects are Caucasian. Remember that Zone VI is the average zone for light skin.

If you are going to try using an in-camera meter in the ways described in this book, you will have to take these factors into consideration. For example, if you fill the frame of the camera with the area you are trying to meter, the fact that the meter is center-weighted will not matter. If you are metering a model's hair, this means getting close enough so that all you can see through the viewfinder is her hair. If you then center the needle or dot by adjusting the f/stop or shutter speed, you will have placed her hair on Zone VI if this is the way your meter is

calibrated. (You can check your meter's calibration by comparing your readings to those of a handheld meter or having it checked by a camera repair shop.) Let's say the exposure the meter recommends is f/8 at 1/30 of a second. If you were to stop down three stops from this exposure, you would then have the correct Zone III exposure for her hair: f/22 at 1/30 of a second.
To measure the overall contrast of the subject, you will have to fill the frame with the Important Highlight Area, center the needle, and make note of how many stops' difference there is between the shadow reading and the highlight. If the meter recommends an exposure of f/1.4 at 1/30 when you meter the shadow area and f/5.6 at 1/30 when you meter the highlight, you know that there is a four-stop difference between the two areas. Obviously, this system will work, but at best it is complex and cumbersome. If you find yourself having to do this very often, you would probably be better off investing in a decent spot meter. The 35mm camera is a specialized tool that is designed to be quick and easy to use. With practice and an awareness of how the in-camera meter is designed, you won't take long to develop working methods that are efficient for your shooting habits. Often you will see experienced 35mm photographers taking a meter reading from their own hands before shooting. By metering a flesh tone and making use of the meter's automatic Zone VI placement, they are using a derivative of the Zone System.

Q: How does the Zone System apply to the use of electronic flash?

A: Once upon a time, the correct exposure with electronic-flash units was routinely calculated by carefully measuring the camera-to-subject distance with the range-finder on the lens and using this to select the proper f/stop with the exposure dial on the flash. As noted in an earlier chapter, with modern electronic-flash units, the exposure is determined by a thyristor circuit that controls the output of the flash. Dedicated flash units automatically adjust both the f/stop and shutter speed of the camera. You must use the shutter speed that is synchronized with your flash, usually 1/60 or 1/125 of a second (check your owner's manual).

The Zone System allows you to accurately measure the contrast of your subject. If you determine that the contrast is too great, you have two choices: You can base your exposure on the shadow areas and reduce the contrast of your negative by decreasing the negative's development time, or you can expose for the highlights and add more light to the shadow areas with fill-flash. This process usually involves setting the flash to 1/2, 1/4, or 1/8 power, depending on how much fill you need. The instructions provided with your flash will explain how this is done. The second procedure is especially useful in backlighting situations with both black-and-white and color films. (For detailed explanations of how the Zone System applies to electronic strobes, see Chapter 11, "The Zone System and Studio Photography.")

Q: How can I override my camera's automatic metering system?

A: As we discussed earlier, most built-in light meters are designed to operate "automatically," which means that when you adjust one of the exposure controls, the meter will internally adjust the other to maintain its recommended Zone V exposure. There are two types of built-in meters:

- Aperture-priority meters allow you to choose the aperture you prefer, and the meter will automatically adjust the shutter speed.
- Shutter-priority meters allow you to choose the shutter speed you prefer, and the meter will automatically adjust the aperture.

To use an exposure other than the one recommended by the meter, you will have to override these automatic functions using one of the following methods, depending on how your camera is designed (check your owner's manual).

Manual Setting. If your camera has a manual mode, you can set both the aperture and the shutter speed to the exposure of your choice. For example, if the meter recommends an exposure of f/11 at 1/30 for an area you wish to print as Zone III, you can simply change your setting to either f/22 at 1/30, or f/11 at 1/125. These exposures are equivalent and are both two stops darker than the meter's recommended setting (Zone V).

Exposure Compensation Dial. This function allows you to change the meter's recommended exposure by up to three stops darker (–1, –2, –3) or one to three stops lighter (+1, +2, +3). Some cameras use (–1/2, –1/4) for darker exposures and (–2, –4) for lighter exposures. Refer to Appendix R if the use of these exposure factors is not clear.

Memory Lock. This function allows you to take a meter reading of a given area of the scene, lock that recommended exposure into the meter, step back, and use this exposure for the whole picture. Because the meter's recommended exposure is Zone V, this means finding a part of the subject that you previsualize as middle gray in the final print and locking in the recommended exposure for that area. Some photographers carry a Neutral Gray Card with them to use in situations like this. A variation on this procedure would be to meter an area you previsualize as Zone III and stop down two stops from the meter's recommended exposure.

Film Speed Adjustment. If your camera has no other way of overriding its automatic function, it is usually possible to change the meter's recommended exposure by resetting the ISO/ASA. Remember that when ASA numbers double (for example, from ASA 400 to 800), the amount of exposure required halves. Halving your ASA setting will increase the exposure by one stop. Review "Measuring Zones," in Chapter 4, "The Zone." For example, imagine that you are metering a wall and your camera recommends f/16 at 1/60 for a film rated ASA 400. That exposure would render the wall Zone V. To place the wall on Zone IV, change the ASA from 400 to 800. The recommended exposure would then be f/22 at 1/60 or equivalent. To place the wall on Zone VI, change the ASA from 400 to 200. The recommended exposure would then be f/11 at 1/60 or equivalent. Remember to reset the ASA to your normal speed for that film after taking the picture.

There are cameras with DX code-reading systems that automatically set the ASA for you, and there are some "fully automatic" cameras that do not allow you to override the metering system. The Zone System can't be effectively used with these cameras.

Q: What role do ISOs (ASAs) play in applying the Zone System to my photography?

A: Most photographers think of ASA as simply a rating of a given film's sensitivity. This is true as far as it goes, but there is more to it than that. Earlier, I said that ASA numbers can be related to f/stops and shutter speeds in the following way: As the ASA number gets smaller, the amount of exposure needed increases. Keeping in mind that the amount of exposure determines the negative's shadow density, we can state the preceding rule in another way: The lower the ASA number you use for a given film, the more density and detail you will get in the shadow areas of your negatives and prints.

Taking this into account, you can see that the important question is this: "What ASA should I use with my film to get the best shadow detail?" Many photographers have discovered from experience that the manufacturer's recommended ASA doesn't give them the amount of shadow detail they need in their work. In other words, after carefully placing a shadow reading on Zone III using ASA 400, you may find that the negative is underexposed by one stop (Zone II). The reason is not that the placement is incorrect, but rather that the photographer overestimated the speed of the film. The remedy is to shoot the film at ASA 200 instead. This would give the film one stop more exposure every time and guarantee that Zone III will always print with the detail you expect.

There are, of course, many situations in which you need to use a higher ASA than the manufacturer recommends. This is called pushing the film, and it is often necessary in low-light situations. Do this with films that are relatively fast, such as Kodak 400TX (Tri-X) or Ilford HP-5+. Faster films generally have more exposure latitude than slower films. The only way to determine what ASA will suit your needs is to test your film and developer.

I need to make one last point about the effect of changing a film's ASA. Using a lower ASA will improve your shadow detail, but it will also add density to the highlight areas of the negative. To compensate for this, you must establish a Normal Development Time that is shorter than the manufacturer recommends. The reverse is also true. If you push the ASA of a film, you must increase the film's Normal Development Time.

Q: Will digital photography make the Zone System obsolete?

A: The answers are no and yes. Digital imaging techniques have changed our approaches to photography in ways that we are just beginning to comprehend. For many years, it has been possible to digitally manipulate scanned or digitally shot images designed for reproduction with methods so convincing that our notions of "photographic realism" no longer have conventional meanings. As profound as these changes have been, they have had relatively little effect on photographers committed to the aesthetics of the classic "fine print." The dream of many photo-artists has been that computers would provide an easy alternative to the labor-intensive multiple printing techniques perfected by Jerry Uelsmann, among others. But until recently, there has been no way to use digital technology to produce manipulated continuous-toned photographic prints.

As of this edition of this book, all of this has changed. Both inkjet printers and digital cameras have improved to the point that it is now possible to produce exquisite photographic images that are completely satisfying as fine prints. This is why we are now in the midst of what can fairly be called a revolution that rivals the emergence of the roll-film cameras years ago. Photographic film, paper, and chemistry manufacturers who fail to respond to these changes will soon disappear, and many photographers find themselves grappling with adapting to a very different set of aesthetic and technical assumptions.

However, it is not a question of digital processes precisely replacing the qualities of fine silver prints. There will always be distinctions that are important to specialists. Digital processes offer the opportunity to produce work that has extraordinary qualities that, although different from silver-based work, is fully resolved in its own terms. The formal and aesthetic equivalency of oil

painting to pastels is a good example. It's simply impossible to imagine the world of fine art without one or the other. What will most likely happen is that silver-based photography will become a specialized practice reserved for those devoted to its qualities. This seems inevitable given the proliferation of digital cameras in both the amateur and the professional markets.

What distinguishes digital photography is its ability to render fine prints on a vast array of paper surfaces; and the fact that pixel-editing software allows photographers to move relatively easily from the realms of objective, documentary-related ways of shooting, to the open, abstract, and complexly layered image-making modes typical of collage/montage artworks.

But for all the potential benefits of digital photographic processes, the transition requires a detailed understanding of radically new technologies. The fact that the Zone System has a great deal to offer photographers considering this transition is the premise behind Chapter 10, "The Zone System and Digital Photography," which has been added to this edition. You will find that it covers all the issues related to this process in great detail.

Q: How do I know what the Normal Development Time is for the film and developer I use?

A: Film and developer manufacturers routinely recommend a range of standard development times for their products. These are useful as starting points, but you can't depend on them for reliable results. The problem is that the correct Normal Development Time for your needs depends on a number of variables, including the following:

- The ASA you use
- The rate of agitation you use while developing the film
- The dilution and temperature of the developer
- The grade of paper you routinely use
- Whether you use a condenser- or diffusion-type enlarger (see Appendix P)
- The pH of the water in your area

Even if you try to follow the manufacturer's instructions exactly, your times could still be different from those they recommend. The only way to determine the Normal, Expansion, and Contraction development times that are correct for your photography is to do a test with your camera and meter that takes all these factors into consideration. The following two chapters outline two testing methods for this purpose.

chapter **eight**

Zone System Testing: Method 1

Introduction

This chapter and the next deal exclusively with testing films, developers, and papers for use with the Zone System. For this reason, photographers who are exclusively digital can safely skip these two chapters and move ahead to Chapter 10, "The Zone System and Digital Photography."

In the hands of serious photographers, the Zone System can be a powerful, creative tool. Zone System testing is important because it provides you with valuable information and demonstrates that your camera, film, and light meter can work together in a direct and systematic way.

Unfortunately, my experience has been that some students become frustrated and give up in their efforts to master the system when confronted with the need to test their equipment and film. The problem is that most testing procedures are too abstract or complex to be practical. Of course, a certain amount of discipline and persistence are required to complete any test, but photographing gray cards under floodlights or plotting curves on graphs is going to excite only photographers who enjoy working scientifically. Most of us would rather just take what we have learned directly into the world and begin using it.

The main difference between the testing method outlined in this chapter and others is that it allows you to work directly with all the problems and variables you will encounter in your work. In one sense, this makes the test more difficult. In a studio, you don't have to worry about clouds, changing light, or all the other factors that are so much a part of photography in the real world. The advantage of this approach is that a test of this kind saves you from having to do one test in the studio and another in the field to see whether your laboratory results really work. For a photographer with the necessary time and patience, a test of this sort will yield a wealth of information and confidence. The finished print will be tangible proof of your ability to control exposure and development.

This book offers two approaches to Zone System testing. In different ways, each method allows you to begin applying the Zone System to real-life shooting situations right away. Method 1, in this chapter, is adapted from a number of the more classic methods outlined in other works on this subject. This test is designed to give you the maximum amount of information with the minimum amount of time and film. Method 2, in the next chapter, is designed for experienced photographers who would like reliable guidelines as starting points for determining their personal working ASA, Normal Development, Expansion, and Contraction times.

Whichever method you use, it is important that you read the procedure through completely and make sure that you understand it before you start. It is also a good idea to work through this test with a friend to help you record and organize the steps.

Appendix U, which includes the Zone System Testing Checklist and Exposure Record, will help you keep track of your procedure and record your results. Instructions for sheet-film users are enclosed in boxes. Make as many copies of the Exposure Record because you will need one for each test you do.

Having done this test with dozens of students, I can confidently say that your results should be within predictable limits. (See the development charts for Method 2 in Chapter 9, "Zone System Testing: Method 2.") In a sense, you aren't really testing the materials so much as your ability to make your equipment, film, and processing procedures respond as they should.

If you finish Method 1 with unreasonable results (for example, ASA 1000 or 50 for Tri-X), you have definitely done something wrong. If this happens, review each step carefully until you are sure you understand where the problem is, then start again.

Instructions are included for testing both roll and sheet film. The results from these tests will apply only to films with ASA ratings equal to the film you are testing. Method 2 lists a number of different films and the results obtained from testing them for Normal, Normal Plus, and Normal Minus times. Using these charts as a reference, you are able to extrapolate the results from one film to another with a different ASA, but doing so requires a great deal of experience. In general, I recommend that new Zone System users retest when they change films or developers.

Choosing a Photographic Paper

Although paper grade or variable contrast filter 2 is standard for Normal contrast negatives, experienced photographers know that every brand and grade of paper has unique characteristics. One of the objects of Zone System testing is to match the contrast of your negatives to your favorite type and grade of printing paper. Having standardized your normal printing, you can use the higher and lower paper grades when extreme Expansions or Contractions are required to compensate for very low- or high-contrast subjects.

For those who have not decided what paper to use for this test, I recommend that you begin researching the range of different paper surfaces and tones that are available by comparing the paper sample books available at most photographic supply stores.

No one brand or type of paper is ideal for all uses, but in general, the more expensive graded or variable contrast fiber-based papers are preferred for exhibition-quality printing. Resin-coated papers are ideal for volume production printing because they process much more quickly and require much less washing and drying.

[**note**] In a previous edition of this book I wrote, "in general, resin-coated papers aren't recommended for exhibition-quality work because they haven't been proven to be archival." But then a Kodak representative pointed out to me that the same resins are used for both RC papers and the bases of Kodak films. Color printing papers are also all resin-coated.

An important factor to consider when choosing a personal Normal grade of paper is the light source of your enlarger. Condenser enlarging light is inherently more contrasty than light from cold-light or diffusion enlargers. This means that you will generally use lower paper grades when printing with condenser enlargers. (For more information on this factor, see Appendix P.)

The Use of Equivalent ISO (ASA) Numbers

Testing Method 1 is designed to allow you to test your film at a wide range of ASA numbers on the same roll or box of film. In this way, you will determine which ASA is best for your purposes. To do this, you are going to bracket your exposures on each roll according to a predetermined plan. The principle that governs this process is very simple.

Bracketing your exposures is the same as changing the ASA on your meter. Consider this demonstration:

1. Set your light meter to ASA 400 and place meter number 12 opposite the Zone V arrow. If you were testing Tri-X, normally rated ASA 400, and had placed meter number 10 on Zone III, your first exposure would be f/16 at 1/60 of a second (see Figure 8.1).

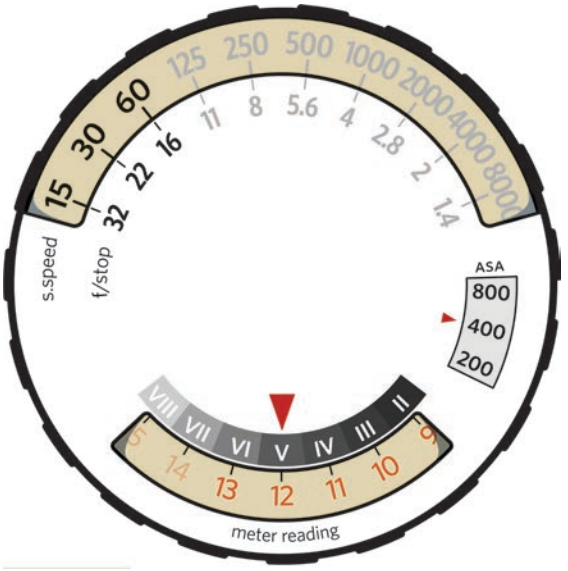

FIGURE 8.1 Zone III placement of meter number 10 at ASA 400. Exposure: f/16 at 1/60 of a second.

2. Stop down one-half stop from this starting point without changing your ASA. Your exposure is now 1/60 of a second at f/16–22 (see Figure 8.2).

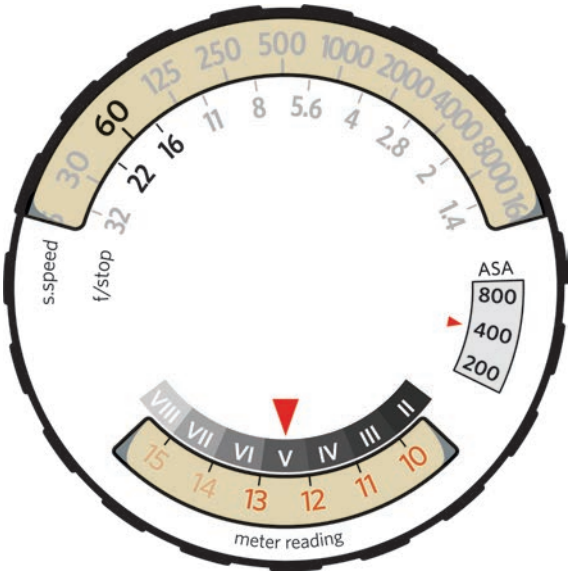

FIGURE 8.2 One-half stop less exposure at ASA 400.
Exposure: f/16–22 at 1/60 of a second.

3. If, instead of stopping down, you were to reset your ASA to 600 without changing your placement of meter number 10 on Zone III, the result would also be 1/60 of a second at f/16–22 (see Figure 8.3).

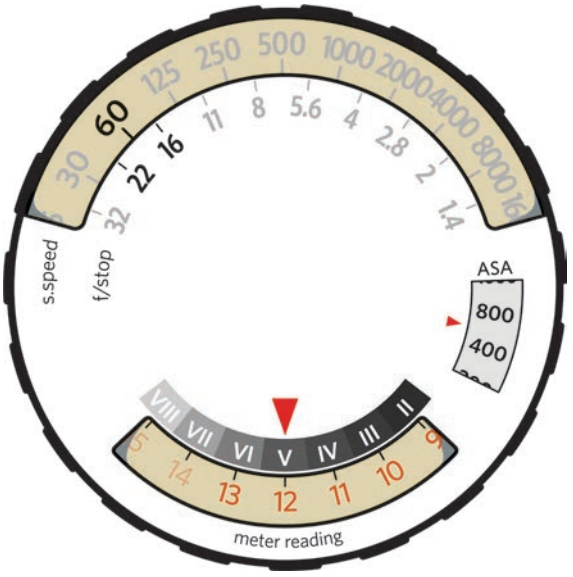

FIGURE 8.3 Zone III placement of meter number 10 at ASA 600 between ASA 800 and 400.
Exposure: 1/60 of a second at f/16–22.

These examples demonstrate that after you have established your placement of the Important Shadow Area, stopping down has the same effect as shooting at a higher ASA number. As far as the film is concerned, there is no difference. Of course, this principle also operates in the other direction: Opening up is the same as using a lower ASA number.

In testing Method 1, you will be filling in a column on the Exposure Record labeled "ASA" (column C in Figure 8.5). The ASA numbers that you enter in this column will be the ASA numbers that are equivalent to the exposures in the adjacent columns. For example, Figure 8.3 shows that ASA 600 is equivalent to stopping down one-half stop from f/16 at 1/60 of a second at ASA 400. At no point in the test should you change the ASA setting on the dial of your meter. Set your ASA dial to the number recommended by the manufacturer; then stop down or open up as indicated by the exposure plan that is appropriate for your film format. After you have calculated and entered your exposures on the Exposure Record, enter the equivalent ASA numbers in the column to the right.

This process will be reviewed here, but it may be useful for you to work with this concept using your meter dial until it is clear.

Zone System Testing: Method 1

This test has three objectives:

1. To establish a personal working ASA (also called your Exposure Index, or EI) for whatever film and developer you decide to use. You are trying to find the highest ASA for your film that will give the best shadow detail in your negatives and prints. The result of this test may be a different ASA than the manufacturer recommends, but after it is established, it will be a standard you can depend on for good results.
2. To determine your Normal Development Time. This is the time you will use for subjects with Normal contrast. It will also be the basis for your Expansion and Contraction development times.
3. To determine a standard printing time. Whenever you make a print, there is a minimum amount of exposure under the enlarger at a given f/stop that will make the clearest part of the negative (Zone 0) as black as it can get. Let's say this exposure time is 22 seconds. If 22 seconds is truly the minimum time it takes to make the film base as black as it will print, then 24 seconds (or for that matter 500 seconds) will not make Zone 0 any darker. What the extra exposure would do is make all the other tones in the print darker. Any less exposure will not be enough to give you a true black anywhere in the print.

A simple test outlined in this chapter will determine your minimum time for maximum black exposure, which you will use as a standard for the test. Because this time will change when the enlarger is focused higher or lower, you must also choose a standard image size. Your film test results will apply regardless of what size print you decide to make in the future.

For this test, you will need the following materials:

1. A camera, tripod, and cable release. Test your camera for light leaks and shutter accuracy before you start.

2. A reflected-light meter. A spot meter is preferable because it is easier to get an accurate and consistent reading. Whatever light meter you use, be sure that it is accurate or that you know how to compensate for it if it isn't. (See Appendix S.)
3. Film. I have included instructions for testing both sheet and roll film. If you are doing this test with roll film, you will need four rolls of your favorite film. For sheet-film testing, you will need 24 sheets. After you have loaded your 12 film holders, divide them into four sets with three holders (each containing two sheets) in each set, and label them A, B, C, and D. Number each set from 1 to 6. This will give you four number 1 sheets (1A, 1B, 1C, 1D), four number 2 sheets, and so on.

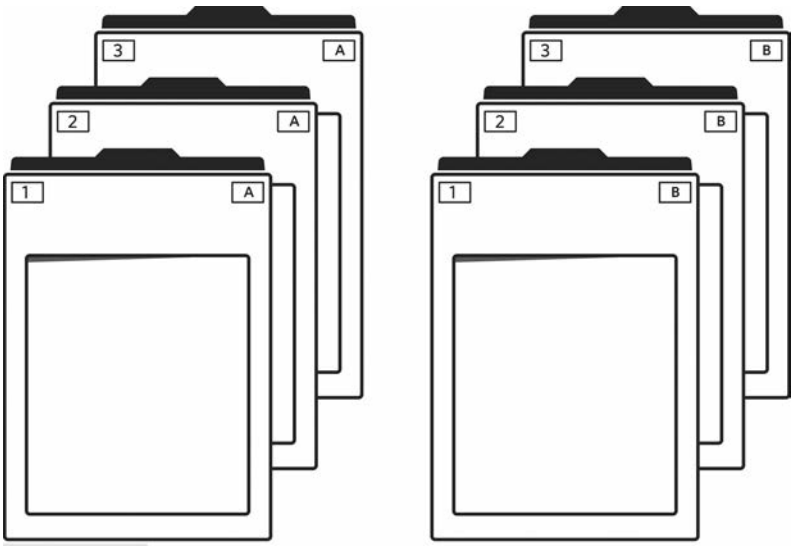

FIGURE 8.4 Sheet film holder arrangement. Sets C and D are not shown.

4. Developer. You will need enough of your favorite developer to process the film required. Be sure you dilute the developer and control the temperature very carefully. It is important that the temperatures of the developer, stop bath, and fixer are all the same. (For more information about developers and films, consult Appendixes H and I and Testing Method 2.)
5. Photographic paper. Use a normal grade of paper. Grade or multi-contrast filter #2 is normal for most brands. Check the manufacturer's information sheet if you aren't sure. If you prefer a particular type or grade of paper, you can use it if you keep in mind that this will become your standard paper for as long as you use the same film and developer. (See Appendix P for information on the role different enlarging light sources play in choosing a Normal grade of paper.)
6. A Neutral Gray Card. This will provide a visual reference in the printing part of this test.
7. If you are testing sheet film, you will also need a large note pad and marker.
8. Select an appropriate test subject. For reasons discussed earlier, you should do this test outdoors or under your normal working conditions. A light-colored house makes an ideal subject because it is usually easy to meter a full range of zones, from Zones II and III for

dark shrubs or woodwork to Zones VII and VIII for the house itself. If it is a clear day or slightly overcast, the contrast will remain constant for a reasonable amount of time. On partly cloudy days, the light is too unstable. If you choose not to use a house, any subject that gives you a full range of zones will do.

Whatever subject you choose, it is important that you have clearly visible and logical areas of Zones II, III, and VII. I emphasize the word "logical" because in the end, it is your judgment of the final print that will determine the results of this test. The goal is to end up with a beautiful, full-toned rendering of the test subject. If you keep careful records of how you make this print (the ASA, placement, and development time), you will have established these as standards for future use.

Careless previsualization can throw off the whole process. For example, if you choose the darkest part of the subject (logically Zone I) as your Important Shadow Area, you might succeed in rendering that area as Zone III in your print, but your negative will be overexposed by two stops, and this will give you misleading results.

It is also important that the subject you choose has Normal contrast. If the test subject is too flat or too contrasty, it will confuse you unnecessarily. Many of my students are casual at this point and it ruins their results. The time you spend finding the perfect subject will be well worth the effort in the end.

Begin by making a simple form like the one shown in Figure 8.5 or make an enlarged copy of the Exposure Record on page 311. Use a copy of the checklist on pages 312–313 to keep track of your progress.

FILM: _____

	ZONES										A	B	C	
SUBJECT	0	I	II	III	IV	V	VI	VII	VIII	IX	S SPEED	F STOP	ASA	DEV
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

FIGURE 8.5 Exposure Record.

[Step 1]

Assuming that you are using a house for this test, make a simple sketch of it above your form (as in Figure 8.6). It doesn't have to be detailed as long as it outlines all the important areas you are reading.

FILM: _____

		ZONES									A	B	C	
SUBJECT	0	I	II	III	IV	V	VI	VII	VIII	IX	S SPEED	F STOP	ASA	DEV
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

FIGURE 8.6 Step 1: Sketch and Exposure Record.

[Step 2]

Carefully meter all the important shadow, middle, and highlight areas of the house, and write the meter numbers on the sketch (as in Figure 8.7). Try to record as many numbers as you can. You will have to check these readings often throughout this test to make sure they don't change. Again, make sure your subject has prominent areas of Zones II, III, V, and VII (and Zone VIII if possible).

FILM: _____

					ZONES						A	B	C	
SUBJECT	0	I	II	III	IV	V	VI	VII	VIII	IX	S SPEED	F STOP	ASA	DEV
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

FIGURE 8.7 Step 2: Sketch with EV meter readings.

[Step 3]

Place the meter readings from the house on the Zone Scale according to your previsualization (as shown in Figure 8.8).

Remember that one of the primary objectives of this test is to determine your Normal Development Time. For this reason, it is very important that your placements be logical and that all the values fit properly on the scale. For example, a common mistake would be to place the meter reading for the very dark part of the subject on Zone III instead of Zone II. This would result in a print that looks one stop lighter in the shadow areas than you would expect. Zone III is the appropriate zone for well-lit, fully textured, dark subject areas such as green foliage and brown wooden doors. Also, if the contrast of your test subject is too flat or too contrasty—in other words, if the Important Highlight Area falls on Zone VI or VIII instead of Zone VII—find a better house.

FILM: TRI-X

	SUBJECT	ZONES 0	I	II	III	IV	V	VI	VII	VIII	IX	A S SPEED	B F STOP	C ASA	DEV
1	TEST HOUSE			8	9	10	11	12	13	14					
2															
3															
4															
5															
6															
7															
8															
9															
10															

FIGURE 8.8 Step 3: Sketch and Exposure Record with placements.

[**note**] Don't be surprised if all your meter readings don't fit as perfectly on your Zone Scale as they do on my ideal illustration. If, for example, after you place your Important Shadow Area on Zone III, the area that you wanted to be Zone VI falls on Zone VI 1/2, simply record this information on the Exposure Record and take it into consideration when you evaluate your final test print. What is important is that you have clearly visible areas of Zones II, III, and VII.

[Step 4]

Set up your camera and put the Neutral Gray Card in the picture in a place where it reads Zone V. Remember that although the card itself is Zone V, if it is put in a dark area of the scene, it could fall on Zone III or IV. **Keep moving it around until its meter reading falls on Zone V.**

[Step 5]

Calculate your exposures and fill in the blank spaces of your Exposure Record using the following procedure. You will expose the first frame of your test roll or the number 1 sheets of your four sets of film using the manufacturer's recommended ASA. The exposures of the remaining frames will be bracketed by half stops for one or two full stops in both directions from this starting point. As explained in the introduction, bracketing exposures has the same effect as changing the ASA.

Under column A, labeled "S Speed," list the shutter speed chosen for your test exposures. For greater accuracy, it is important that you bracket using the f/stops rather than the shutter speeds. Choose a shutter speed that allows you a two-stop range of apertures on either side of the starting point for roll-film tests and one stop above and below for sheet film.

Under column B, labeled "F/Stop," list the apertures of your test exposures using the formulas listed next. Use plan A for roll-film tests and plan B for sheet-film tests.

[**note**] You will expose the first frames of your test rolls and sheets using the aperture recommended when the meter is set at the standard ASA for the film used. Thereafter, you will adjust your exposure by half stops in both directions from this starting point without changing the ASA on the meter's dial. Only the aperture should be changed during these test exposures.

Exposure Plan A for Roll Film

Expose your test rolls as follows:

FRAME	APERTURE SETTING
1	Normal exposure at the film's standard ASA
2	One-half stop less exposure than frame 1
3	One full stop less exposure than frame 1
4	One and one-half stops less exposure than frame 1
5	Two full stops less exposure than frame 1
6	Same exposure as frame 1
7	One-half stop more exposure than frame 1
8	One full stop more exposure than frame 1
9	One and one-half stops more exposure than frame 1
10	Two full stops more exposure than frame 1
11	Blank
To end	One full stop more exposure than frame 1

Exposure Plan B for Sheet Film

Expose the sheets labeled 1–5 of sets A, B, C, and D as follows:

SHEET	APERTURE SETTING
1 (A, B, C, D)	Normal exposure at the film's standard ASA
2 (A, B, C, D)	One-half stop less exposure than sheet 1
3 (A, B, C, D)	One full stop less exposure than sheet 1
4 (A, B, C, D)	One-half stop more exposure than sheet 1
5 (A, B, C, D)	One full stop more exposure than sheet 1

Under column C, labeled "ASA," list the equivalent ASA numbers for the exposures listed in columns A and B.

[**note**] Modern light meters list ASA numbers that double from 6 through 6400, with one-third-stop markings in between. For the purposes of this test, we are bracketing by half stops. Use equivalent ASA numbers that are halfway between these printed numbers. For example, between ASA 400 and ASA 200 would be ASA 300 or 250. The actual number you use doesn't matter as much as consistency. Of course, your meter numbers and exposures will probably be different, but at this point, your Exposure Record and sketch should be similar to Figure 8.9. Study this illustration carefully. It is important that the logic of these settings is clear.

FILM: TRI-X

	SUBJECT	ZONES 0	I	II	III	IV	V	VI	VII	VIII	IX	A S SPEED	B F STOP	C ASA	DEV
1	TEST HOUSE			8	9	10	11	12	13	14		1/125	F/8	400	NORMAL
2	"											"	F/8-11	600	
3	"											"	F/11	800	
4	"											"	F/11-16	1000	
5	"											"	F/16	1600	
6	"											"	F/8	400	
7	"											"	F/8-5.6	300	
8	"											"	F/5.6	200	
9	"											"	F/5.6-4	150	
10	"											"	F/4	100	
11	UNEXPOSED														
12	REMAINING FRAMES											1/125	F/5.6	200	

FIGURE 8.9 Step 5: Sketch and Exposure Record filled in completely.

[Step 6]

Recheck the key meter readings of your test subject **to make sure the light hasn't changed**. (It will take you much less time to actually meter your subject and fill in the Exposure Record than it took you to read through the previous step.)

Roll Film

[Step 7]

Expose the first roll of film using the exposures listed on the Exposure Record. Use your lens cap for the blank frame on each roll. The remaining frames are exposed to keep the number of exposed frames being developed consistent with your usual procedures.

Expose the remaining three rolls in exactly the same way, making sure the light hasn't changed between rolls or exposures.

Sheet Film

Using the exposures listed on the Exposure Record, expose the four sets of film holders according to the following procedure. This will ensure that the exposures of all four sets are identical. It will also help you identify each sheet for future reference.

1. Put your large pad in the test area in a clearly visible place. The writing on this pad will be easier to read in the test prints if you avoid putting it in a brightly lit area of the scene.
2. In large letters, write "1A" on the pad; then expose sheet 1 of set A as listed on your Exposure Record.
3. Write "1B" on the notepad and then expose sheet 1 of set B using the same exposure you used for sheet 1A. Label sheet 1 of sets C and D on the note pad and give them the same exposure.
4. After stopping down one-half stop as listed on the Exposure Record, label and expose sheet 2 of sets A, B, C, and D.
5. Follow the same procedure to expose and label the rest of the sheets in each set.

[Step 8]

After you have exposed all your film, develop one roll or one complete set of sheet film (1A–5A plus one sheet of unexposed film) using your favorite developer. If you have a Normal Development Time you are comfortable with, use it. If not, use a time I recommend in Testing Method 2 in Chapter 9 or refer to the fact sheet that came with the developer. Use the minimum time recommended for your film. Process and dry your film normally.

[**note**] Another great reference for Normal Development Times is the website Digital Truth Photo and their Massive Dev Chart.

Standard Printing Time Test

[Step 9]

To determine the minimum time it takes to achieve the maximum black, perform the standard printing time (SPT) test as follows:

1. Using one of your test exposures, focus your enlarger at the printing size that is normal for your work.

2. Place the blank sheet of film in the negative carrier so the unexposed film covers one-half of the opening. To do this with roll film, you must cut the blank frame in half. Your negative carrier should look like the one shown in Figure 8.10.

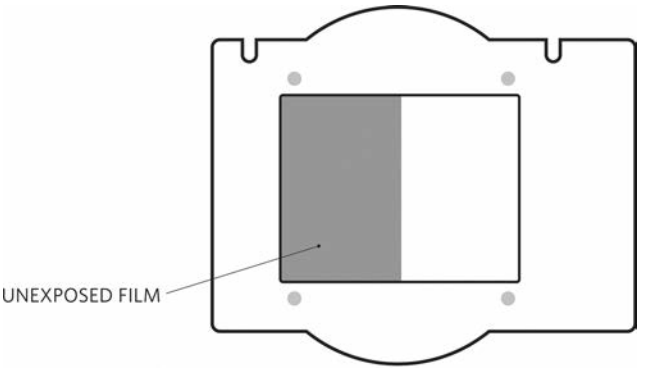

FIGURE 8.10 Negative carrier with film base.

3. Put the negative carrier in the enlarger and make a series of test exposures on a full sheet of normal paper at 2-second intervals. Use an f/stop that is in the middle of your enlarger's range and try to get as many exposures on the test sheet as possible.
4. Develop the print for 2 to 3 minutes in your normal print developer. When this print is processed and dried, it should look like Figure 8.11.

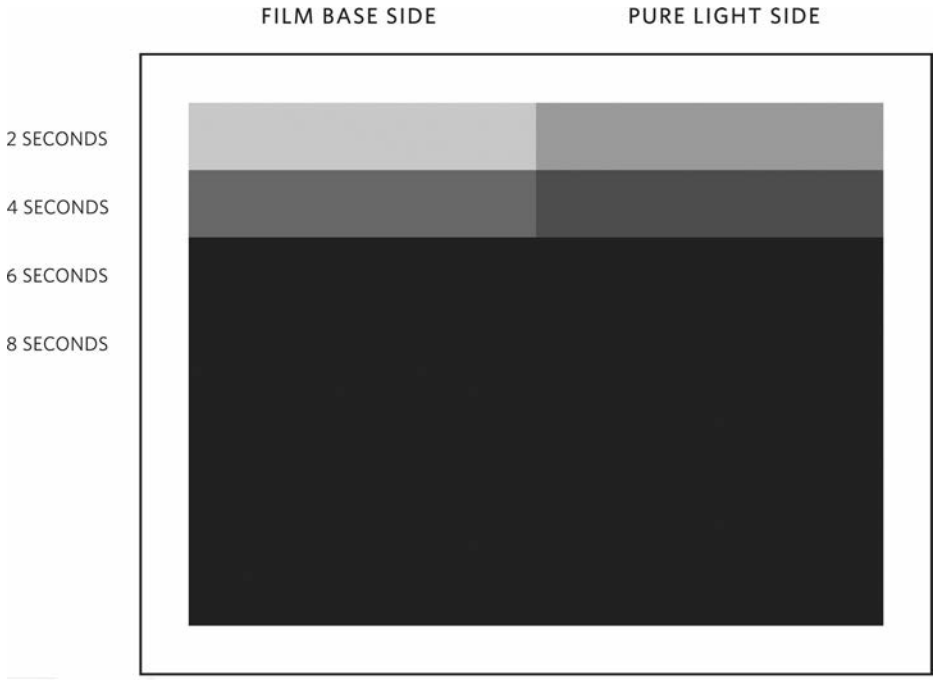

FIGURE 8.11 Test print.

If the division between the two halves of this print doesn't disappear somewhere along the sheet, you haven't reached the paper's maximum black exposure time. Open up one stop and make another set of exposures.

[**note**] You may notice a very faint line between the two halves of this print. Just ignore this. It is important that your test print be dry before you go on to the next step. Most printing papers darken as they dry, and this will affect your judgment of which step is truly black.

5. Count the exposures on the film-base side of the print until you can no longer see the difference between one step and another. The first completely black step on the film-base side of the test print represents the exposure time you are looking for. If this step equals 8 seconds' worth of exposure, your standard printing time is 8 seconds at whatever f/stop the lens is set. Note this exposure for future use.

[Step 10]

[**note**] The steps on the "pure-light" side of the print should already be totally black. Use these for comparison.

Make one straight print of each test frame on a normal grade of paper using your new SPT. If you are testing roll film, remember to write the frame number on the back of each print. This number is the key to the ASA that was used to expose that frame.

Process and dry these prints before you judge them.

[Step 11]

If you are testing roll film, you should now have 10 prints of the test subject. Sheet-film testers should have five test prints. Each print should be a little lighter or darker than the next because the prints represent exposures at different ASA numbers. Arrange these prints in the order that you exposed them. If you have done everything correctly, they should appear as follows:

Roll Film

- Print 5 should be the darkest.
- Print 7 should be lighter than print 1.
- Print 9 should be the lightest.

Sheet Film

- Print 3A should be the darkest.
- Print 4A should be lighter than print 1A.
- Print 5A should be the lightest.

[Step 12]

The next step of this test is judging your test prints. Before you begin, it is important for you to know that it's very easy to choose an SPT that is slightly too long. This can be due to your timer being inaccurate or to the fact that printing papers don't always respond logically to

accumulating amounts of light. Five 2-second exposures might not produce the same effect as one 10-second exposure. Choosing an SPT that is too long will cause you to choose an ASA that is too low. When you get to the point of selecting one print over another, keep this factor in mind. When in doubt, always try a slightly shorter SPT to print your key negative.

You can ignore the test prints that are obviously too light or dark, but two or perhaps three prints should have well-exposed shadow values. At this point, the shadow areas are the only parts of the print in which you are interested. (The highlights of these prints may be too gray or too white, but for now they are not important.)

Looking only at the darker parts of the image, choose the print that in your opinion has the best detail in the shadow areas. The Zone II areas of the print you select should be dark with a trace of detail. The Zone III areas should have good contrast and be fully detailed. Your sketch (see Figure 8.9) will remind you of where these areas are. With this in mind, you should be able to narrow your choice to two prints. Remember that the goal of this test is to find the highest ASA that will give you the best shadow detail in the Zone II and III areas of your prints. If, for example, you are testing Tri-X and the prints representing ASA 300 and ASA 200 both appear to have good shadows, consider ASA 300 your choice. If the ASA 300 print has shadows that are a little too dark, make another print of this negative at a slightly shorter SPT and see whether it is acceptable.

If the shadows of the ASA 300 print are acceptable but the highlights are much too light, choose the ASA 200 print instead. The reason is that step 13 involves correcting the development time of your key negative. If the ASA 300 negative has good shadow detail but requires a reduction in the highlights, shortening the development time may reduce the shadow densities below a usable limit. If this is the case, the extra density in the shadow areas of the ASA 200 negative will give you a little leeway. Using this line of reasoning, you should be able to select the correct ASA for whatever film you are using. Having done this, you are now interested in only one key frame or one sheet of your test rolls or sets.

Don't be surprised if the print you choose represents an ASA that is lower than the manufacturer recommends. This is very common. However, if you end up with an ASA that is unrealistically high or low (for example, ASA 150 or 600 for 400TX), you have probably made a mistake. Once again, the first thing to check is the SPT. Another common mistake is choosing an illogical area for Zone III. Consider your previsualization very carefully before you make your exposures. Placing the shadow on the wrong zone will throw off your judgment at this stage of the test.

[Step 13]

The last step of this test is judging the highlights of your key print. The procedure for this part of the test is to increase or decrease the development time of your duplicate test rolls or sets until you find the exact time that will allow your key frame to print well on a normal grade of paper. This will work only if the contrast of the test subject was Normal to begin with.

Refer to your sketch to see which areas fell on Zone VII. If the Zone VII areas of the print you selected for the best shadow values (again, refer to your sketch) are light gray and detailed

to your satisfaction, then the amount of time you developed that negative is your new Normal Development Time. Congratulations! If the highlights of your key print are too dark, develop your second roll for 20 percent more time than you developed the first roll.

[**note**] Increasing the development time will slightly increase the density of the negative's film base. For this reason, a slightly longer SPT may be needed to keep the shadows from printing too light. If an extreme increase in the development time is required, you may be able to move to the next higher ASA number.

Sheet-film users should develop all six sheets of set B in spite of the fact that you are interested in only one key frame. It is important that you keep constant the number of sheets being developed in a given quantity of developer.

If the highlights of your test print are too white, develop set B or your second roll of film for 10 percent less time than the first set. Make a print of the key frame.

At this point, you should be very close to having a perfect print. If, for some reason, you're still not satisfied with your results, you still have two identical sets of test film with which to work. By continuing this process, you will eventually end up with a good print that will embody your new working ASA and Normal Development Time. These will apply whenever you use that combination of film and developer to make prints of any size.

Expansion and Contraction Development Times

The following formulas will give you a shortcut method of computing your Normal Plus and Normal Minus Development times. A pocket calculator will make these computations very simple. Notice that special procedures are necessary to achieve good results with Expansions or Contractions of more than N + 2 or N – 2. (Refer to Appendixes K and N for more information on extreme Expansion and Contraction development and the use of compensating developers.)

[**note**] You will probably have to adjust the development times that you derive from these formulas as you go along. Keep careful records of your results.

STANDARD FILMS

Normal Minus

To determine your Normal Minus Development times, start with your new Normal Development Time and follow this procedure:

- For your N – 1 time, multiply your new Normal time by 0.7.
- For your N – 2 time, multiply your new Normal time by 0.6.

For example, if your new Normal Development Time is 10 minutes, your N – 1 time would be 7 minutes, and your N + 2 would be 6 minutes.

Normal Plus

To determine your Normal Plus Development times, the procedure is slightly different.

- For your N + 1 time, multiply your new Normal time by 1.4.
- For your N + 2 time, multiply your new N + 1 time by 1.4.

For example, if your new Normal Development Time is 10 minutes, your N + 1 time would be 14 minutes, and your N + 2 time would be 19 1/2 minutes.

T-GRAIN FILMS

Because T-Grain films are unusually responsive to changes in development time, the Expansion and Contraction formulas just listed don't apply to these films. When processing T-Max or Delta films in the standard dilutions of most developers, use the following formulas to compute your Normal Plus and Normal Minus times.

Normal Minus

To determine your Normal Minus Development times when using T-Grain films, start with your Normal time and apply the following formulas:

- For your N – 1 time, multiply your Normal time by 0.9.
- For your N – 2 time, multiply your Normal time by 0.8.

Normal Plus

To determine your Normal Plus Development times when using T-Grain films, apply the following formulas:

- For your N + 1 time, multiply your Normal time by 1.1.
- For your N + 2 time, multiply your N + 1 time by 1.1.

[**note**] The times you derive from these formulas should be considered only as starting points for determining the exact Expansion and Contraction times for your development procedures. Keep careful records of your results.

chapter **nine**

Zone System Testing: Method 2

The ever-increasing dominance of digital photography isn't the only unsettling development that photographers have had to cope with in recent years. Until not very long ago, film photographers could count on the stability and consistent quality of products from four of photography's most venerable names: Kodak, Ilford, Edwal, and Agfa.

As of this writing, all four of these companies have undergone major reorganizations and have either discontinued or modified many of the products that were once the foundations of traditional photographic processes. The most important of these changes will be summarized in the technical information offered in this chapter. For example, Kodak has changed the way the company manufactures its films, so we have retested and have new development times for all its most popular films.

[**note**] There has been a lot of confusion about the extent to which Kodak's films are different from their predecessors. They, of course, have new names, but Kodak's official word is that all the company has done is relocate its manufacturing facilities and changed the way its emulsions are applied to the film bases. Also, there are websites that claim to demonstrate that the classic standards of quality for films such as Tri-X and Plus-X have not changed in meaningful ways. However, many photographers have reported that Kodak's films are simply not the way they used to be. My film-testing collaborator Iris Davis (owner of Davis Black and White, a high-quality custom photo lab in Austin, Texas) and I have conducted extremely careful empirical tests of Kodak's new films, and our results have shown that the grain structures and tonal gradations of Kodak's films are noticeably different from what they were before. The new development data are included below and, unfortunately, we no longer recommend 400TX (Tri-X) or 125PX (Plus-X) as we once did. Kodak's 100TMax (T-Max 100) and 400TMax (T-Max 400) films, however, still give excellent results. (See Appendix I for a description of our testing method and Appendix J for Iris's comments on some of the implications of the digital revolution.)

Many of us mourn the loss of Edwal FG-7, which, for many reasons was one of my favorite film developers.

Another major change is that Agfa-Gevaert no longer produces Rodinal, which was once the developer of choice for photographers looking for the sharpest possible grain. The good news is that another German company, Adox, has taken up the manufacturing of this formula under the new name Adonal, so we are once again able to offer testing results for this unique and important developer.

Despite all these changes, there are still excellent choices available to photographers devoted to film. The problem is that, to get the most from what you have learned about the Zone System, you have to understand in detail how its concepts and principles apply to the range of films and developers still available.

One approach would be to work through the Zone System Testing Method 1, described in the preceding chapter. On the one hand, the experience and information that you can gain from completing such a test can likely be extremely useful. On the other hand, there are many good reasons why you may decide not to begin such a long procedure. You may, for example, already be confident that you know how the Zone System works, or you simply may not have the time required to run a complete test. The problem is that you will still need a reliable ASA and Normal Development Time to effectively apply the Zone System to your photography.

Testing Method 2, described here, is very simple. The first step is to choose your film and to begin photographing using the ASAs and Normal Development Times that I suggest in the charts on pages 112– 116. A wide variety of films and developers are listed there. If your favorites aren't listed, you will have to extrapolate from my times to suit your needs.

The section titled "Film and Developer: Questions and Answers," later in this chapter, offers detailed recommendations for which film/developer combinations offer the best results under specific criteria. Also see Iris Davis's real-world film and developer commentary in Appendix J. Together with the other information provided, this information should help you decide on a film and developer to use to begin your work.

[**note**] Fujifilm Neopan Acros is not included, but you can use the development times for films with similar speeds that are listed as starting points for working with these films.

Normal Plus and Normal Minus Development times are also provided to give you all the information you will need to get started.

The second step is to keep a careful "diary" of your results and use it to modify and perfect your standards. A typical notation in your darkroom diary might look like this:

DATE	FILM	ASA	DEVELOPER	CONTRAST	TIME	RESULT
11/22	400TX	250	HC-110 (B)	N – 1	4 min.	N – 1½

Assuming that your metering and placement were correct, this entry would mean that this negative needed a one-zone reduction in contrast (Contrast = N – 1). Developing it in HC-110 dilution B for 4 minutes reduced the contrast by 1½ zones.

In other words, when you printed this negative on a normal grade of paper, the highlights were generally grayer than you wanted them to be. The result indicates that 4 minutes is too short a time for an N – 1 development in HC-110. The next time you encounter a subject that requires N – 1 development, you could refer to your record and try developing the negative for 4½ minutes instead. This should be closer to the correct time for your work. Eventually, you will arrive at personal times that you can count on for good results.

If your shadow values are consistently too dark, and you're sure that your placements are correct, try using a slightly lower ASA the next time you photograph with that film. An empirical testing method like this one will make you very sensitive to any changes in your image quality. Many experienced photographers find that keeping a running record of their darkroom results is a very useful habit. This approach essentially amounts to doing a Zone System test every time you photograph. If done properly, it is no less rigorous, and the results will be adapted to your personal working methods.

This method has two potential hazards worth mentioning:

1. Any errors in your technique or problems with your equipment automatically become a part of the process. The specific nature of any mistakes or technical flaws will inevitably surface because your results will be inconsistent or illogical in particular ways. You will then have to carefully review your thinking and procedures and tune up your equipment until the problem is resolved. This is a healthy part of any learning process.
2. The visual evaluations you will be making as you go along will necessarily be very subjective. This process is very different from comparing your Zone III, for example, to a printed standard. If, on the other hand, you are consistently happy with the results you get, you will have accomplished a great deal.

Development time recommendations for a variety of films are available from a number of sources. The Digital Truth website contains a comprehensive listing of development times that are extremely useful as references for this process. Ilford publishes a list of development times for a long list of developers and films available on the Web and in many good camera stores. Kodak's data guide for black-and-white films also lists recommended Normal Development Times for Kodak products. Most film manufacturers also have toll-free numbers or websites that offer free technical advice (see Appendix X). Any good camera store can provide you with these numbers.

Ansel Adams's classic book *The Negative* is another invaluable resource for information about developers and developing times. Charts of this kind provide useful starting points for determining your own specifications. You will most likely have to adjust your times as you go along.

About the Development Time Charts

The development times provided in this chapter are the result of extensive tests done under carefully controlled conditions designed for accuracy and consistency and to avoid technical flaws such as reciprocity failure, lens flare, and so on. (See Appendix I for a description of the process used to define these data and Appendix J for commentary by Iris Davis.)

[**note**] For the technically minded, my test negatives were consistently printed at the minimum time that it took to render the film base plus fog density as maximum black on grade 2 paper. The negatives were hand-processed and printed with a diffusion enlarger and machine-print processed.

We began this process by asking a number of basic questions.

Q: Which are the most popular and widely used products?

A: As I mentioned previously, if your favorite film or developer isn't listed here, there should be something comparable that you can use to extrapolate your own time. Film speed is usually a reliable benchmark to use for comparison. If the film you want to try has an ASA close to one we recommend, use our times for that film as your starting point. Developers can generally be categorized by characteristics such as fine grain, high energy, and so on. (See Appendix H.)

Q: What is the highest film speed that renders a fully detailed Zone III and a Zone II that is black with texture?

A: Film manufacturers must necessarily use consistent and scientifically objective criteria for determining the ratings of their films. Photographers, on the other hand, need ASA ratings that they can count on to give them the amount of shadow detail they visualize when considering a given subject. This is a very subjective evaluation and will vary somewhat depending on the kind of work you do and other variables such as the paper grades you like, and so on.

The standard we have used for these tests is conservative and intended to give you as much exposure latitude as possible, the highest ASA, and good shadow detail in Zone III.

Our goals were to produce negatives that would generally be easy to print on a normal grade of paper (grade 2). From this starting point, you can begin developing your own personal standards.

A fundamental principle that all photographers should understand is that the effective speed of a given film varies depending on the developer used. Notice, for example, that 400TMax is rated as ASA 200 when developed in Ilford Perceptol and ASA 400 when processed in Kodak HC-110.

What this demonstrates is that it's important to know as much as possible about how the characteristics of different developers and films interact before deciding on a combination to use as your standard. (See Appendices H and I for more information on this subject.)

Q: What is the minimum development time that renders a fully textured Zone VII and a Zone VIII that is white with some texture?

A: The Normal Development Times recommended by film and developer manufacturers are based on scientific standards such as "developed to a contrast index of 0.56." Anyone so inclined will discover that there are very rational reasons for doing it this way, but all that most photographers need to know is that a given development time will give them negatives with printable highlights.

It is always best to work with minimum times to avoid highlights that are blocked up. Higher than normal grades of papers can be used if more print contrast is needed. (See Appendix L.)

Standard developer temperatures and dilutions were used in the tests charted in this chapter unless the tests indicated that an alternative gave better results.

Agitation rate is another important variable that effects development time and film speed. (My agitation procedure is outlined in Appendix H under "Processing Notes" and in Appendix G.)

The following development times are suggested for diffusion-type enlargers. Reduce these times by approximately 15 percent if you print with a condenser enlarger or if you are processing your film in a Jobo processor. (See Appendix P.)

[**note**] Development times that are shorter than 3 minutes in certain developers are listed as N.R. (Not Recommended) because it's very difficult to avoid uneven development. Also, the times are listed in minutes or fractions of minutes.

Practical experience (and Kodak data sheets, if you look closely) indicates that T-Max developer isn't recommended for use with any sheet film. (See the section on T-Max developer under "Developer Notes" in Appendix H.)

[**note**] These development time charts are listed in the order of my preferences for quality.

Development Time Charts

KODAK XTOL DILUTED 1:1 AT 68 DEGREES (TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
T-Max P3200	2400	15	16.5	18	13.5	12
Delta 3200	1600	15	16	17.5	13.5	12
400TX	200	7.5	10.5	15	5.5	4.5
400TMax	400	9.5	10.5	11.5	8.5	7.5
HP-5+	400	9	12.5	17	6.5	5.5
Delta 400	400	10	11	12	9	8
125PX	64	7	10	14	5	4
FP-4+	64	9.5	13	18	6.5	5.5
100TMax	100	9.5	10.5	11.5	8.7	7.5
Delta 100	80	10	11	12	9	8
Pan F[a]	50	8	11	15.5	5.5	4.5

[a] For this film, we used XTOL as a stock solution.

KODAK D76 DILUTED 1:1 AT 68 DEGREES (TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
Delta 3200	N.R.					
TMax P3200	2400[a]	18	20	22	16	15
400TX	320	8.5	12	16.5	6	
400TMax	400	12	17	N.R.	10	9
HP-5 +	400	8	11	15.5	5.5	4.5
Delta 400	320	11	12	13	10	9
125PX	80	11	15.5	21	7.5	6.5
FP-4+	80	8	11	15.5	5.5	4.5
100TMax	80	10.5	11.5	13	9.5	8.5
Delta 100	100	11	12	13	10	9.5
Pan F	50	13	18	N.R.	5	4

[a] For this film, we used D76 as a stock solution.

KODAK HC-110 DILUTION B (1:7 FROM STOCK OR 1:31 FROM CONCENTRATE) AT 68 DEGREES (TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
TMax P3200	2400	9.5	10	11	9	8
Delta 3200	1600	15	16.5	18	13.5	12
400TX	320	5.5	7.5	10.5	4	N.R.
400TMax	400	6.5	7.25	8	6	5.25
HP5+	200	5.5	7.5	10.5	4	N.R.
Delta 400	320	5	5.5	6	4.5	N.R.
125PX	125	6.5	9	12.5	4.5	N.R.
FP-4+	64	7	10	14	5	4
100TMax	100	6	6.5	7.5	5.5	4.5
Delta 100	80	5.5	6.25	7	5	4.5
Pan F	50	6.5	9	13	4.5	N.R.

ILFORD ILFOTEC HC 1:31 (FROM CONCENTRATE) AT 68 DEGREES (TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
TMax P3200	3200	10	11	12	9	8
Delta 3200	1600	15	16.5	18	13.5	12
400TX	320	5.5	7.5	10.5	4	N.R.
400TMax	400	7.5	8.25	9	6.75	6
HP5+	400	7	9.75	13.5	5	4
Delta 400	320	7	8	9	6.5	5.5
125PX	64	7.5	10.5	15	5.5	4.5
FP4+	80	8	11	16	6	5
100TMax	50	9	10	11	8	7
Delta 100	80	6.5	7.25	8	6	5.5
Pan F	50	7	10	14	5	4.5

KODAK T-MAX DEVELOPER DILUTED 1:4 AT 68 DEGREES (TANK DEVELOPMENT FOR ROLL FILM ONLY[a])

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
400TX	320	5.5	7.5	10.5	4	N.R.
HP-5+	320	7	9.75	14	5	4
Delta 400	400	7	8	9	6.5	5.5
125PX	80	7	10	14	6	5
FP-4+	64	7	10	14	6	5
Delta 100	100	7	7.75	8.5	6.5	5.5
Pan F	32	8	11	16	6	5

[a] T-Max developer isn't recommended for use with sheet film. (See the Kodak T-Max section in "Developer Notes" in Appendix H.)

KODAK T-MAX DEVELOPER DILUTED 1:4 AT 75 DEGREES (TANK DEVELOPMENT FOR ROLL FILM ONLY[a])

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
TMax P3200	1600	11	12	13	10	9
Delta 3200	1600	9	10	11	8	7
400TMax	400	6	6.5	7.25	5.5	4.75
100TMax	80	6	6.5	7.5	5.5	4.5

[a] T-Max developer isn't recommended for use with sheet film. (See the Kodak T-Max section in "Developer Notes" in Appendix H.)

KODAK T-MAX RS DEVELOPER (STOCK) AT 68 DEGREES (TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
TMax P3200	2400	10	11	12	9	8
400TX	320	5	7	10	4	N.R.
400TMax	400	8.5	9.25	10	7.75	7
HP-5+	400	5.5	7.5	10.5	4	N.R.
Delta 400	400	8	8.75	10	7	6.5
125PX	80	7	10	13.5	5	4
FP-4+	64	7	10	13.5	5	4
100TMax	100	9	9.5	10	8	7
Delta 100	100	5.5	6	7	5	4.5
Pan F	50	7	10	14	5	4.5

ILFORD ID-11 DILUTED (STOCK) AT 68 DEGREES (TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
400TX	320	8	11	15.5	5.5	4.5
400TMax	320	8	9	10	7	6
HP-5+	320	8.5	12	16.5	6	5
Delta 400	400	10	11	12	9	8
125PX	80	8.5	12	16.5	6	5
FP-4+	80	9.5	13	18	9	7.75
100TMax	80	8.5	9.5	10.25	7.5	6.5
Delta 100	80	8.5	9	9.75	7	6
Pan F	50	8.5	12	16.5	6	5

ADOX ADONAL (RODINAL) DILUTED 1:25 AT 68 DEGREES
(TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
P3200TMax	3200	11	12	13.5	10	9
400TX	400	6	8.5	12	4	N.R.
400TMax	200	5	5.5	6	4.5	N.R.
HP-5+	320	14.5	20	28	10	8.5
Delta 400	320	6.5	7	8	6	5
125PX	80	4.5	6.5	9	N.R.	N.R.
FP-4+	125	11	15.5	22	8	6.5
100TMax	100	7	8	9	6.5	5.5
Delta 100	50	7.5	8.5	9.5	6.5	6

ILFORD PERCEPTOL DILUTED (STOCK) AT 68 DEGREES
(TANK DEVELOPMENT FOR SHEET OR ROLL FILM)

FILM	ASA	NORMAL	N + 1	N + 2	N – 1	N – 2
400TX	200	12	17	N.R.	10.9	
400TMax	200	12	17	N.R.	10	9
HP-5+	320	13	18	N.R.	9	8
Delta 400	320	10	11	12	9	8
125PX	64	12	17	N.R.	10	9
FP-4+	64	12	17	N.R.	10	9
100TMax	50	12	13	14	11	10
Delta 100	50	13	14	15	12	11
Pan F	32	12	17	N.R.	8.5	7

Remember that the development times listed here are only starting points for determining your own standards.

Film and Developer: Questions and Answers

Students and friends inevitably ask a number of general questions regarding film and developer combinations. The following are my answers to these questions. Keep in mind that these are very subjective responses based on years of testing and working with these products. Other photographers may have different preferences that are appropriate for their work.

[**note**] The detailed explanations for these results can be found in Appendix H in the sections "Developer Notes" and "Film Notes." Also see Appendix I for some personal commentary on films and developers offered by Iris Davis.

Q: What film/developer combination gives the finest grain with good shadow detail and the best overall contrast?

A: Kodak T-Max 100 in HC-110 (B).

Q: What film/developer combination gives the fastest speed with the least grain?

A: Ilford Delta 400 in XTOL.

Q: Which developers give the finest grain with good shadow detail and the best overall contrast with the films you have tested?

A: See the following chart.

FILM	RECOMMENDED DEVELOPER
Kodak P3200	Ilfotech 1:31 from concentrate @ 68 degrees
Delta 3200	HC-110 (B)
Kodak 400TX	Ilfotech 1:31 from concentrate @ 68 degrees
Ilford Delta 400	XTOL 1:1
Kodak 125PX	XTOL 1:1
Kodak T-Max 100	HC-110 (B)
Ilford Pan-F+	XTOL stock

Q: Which film/developer combination gives the finest grain, the fastest film speed, and the best contrast when a very high-speed film is called for?

A: Kodak T-Max P3200 in Ilfotech HC dilution 1:31.

Q: Which developer/film combination gives the fastest speed and maximum grain for special purposes?

A: Kodak T-Max P3200 developed in Adox Adonal.

chapter **ten**

The Zone System and Digital Photography

Introduction

One interesting way to consider the profound transition fine art photographers have gone through in recent years is from the perspective of what it took to become a fully functional practitioner before the digital revolution began.

Not long ago, it was possible to be a completely self-contained photographic artist if you could afford the thousand dollars or so it took to purchase a decent camera, enlarger, timers, trays, and chemicals. Photographic paper was an ongoing expense, but with a little bit of rough carpentry, you could build a sink. And if the room could be made dark enough and if running water was available, you could produce work up to the limits of your talent and aspirations.

The first major shift came when masters such as William Eggleston, Ernst Hass, Susan Meiselas, Larry Burrows, and Alex Webb, among others, opened the doors of color photography for the rest of us. This was an important breakthrough, but one consequence of this was that it never became practical for photographers to maintain their own color labs. During this phase, almost everyone had his film processed at commercial labs, and it was fashionable to develop close friendships with the few independent master printers who operated color printing facilities. This loss of independence was simply the price you paid to be a working photographic artist.

For all the challenges of the digital revolution, one overarching benefit is that it is once again possible to create a fully professional working environment where you can work privately and independently for a relatively small investment. For some artists, the control and freedom this offers is a hugely important gain.

But, of course, there is a vast difference in ambience between a moody, dimly lit, and redolent darkroom and today's photographic workstation with its monitors and inkjet printers. For many artists, this is a very sad loss. For others, it's a dream come true.

And, of course, none of this would be worthwhile were it not for the fact that digital photography is capable of producing fine artwork of the highest quality. I first discovered this quite unexpectedly many years ago when I walked into a fine art photography gallery in San Francisco, and with a wry smile, the owner told me that he had some prints by Graham Nash that he thought I should see. To be honest, I wasn't expecting them to be more than interesting backstage portraits of rock stars, but what happened next completely changed my sense of what a photographic print could be.

He took me to the print viewing room in the back of the gallery and from a drawer pulled a large print that at first didn't seem unusual, that is, until I noticed that it had a deep and rich but somehow soft quality of blacks that I had never seen before. When I realized that it was printed on what looked to be thick fine art drawing paper and he told me it had been made with what he called an "Iris printer" attached to a computer, I was at first stunned and then amazed and delighted! I was having a completely photographic experience through a process I had never even heard of before.

In those days, Iris printers cost more than $100,000, so I knew that my photographic life wouldn't change overnight, but suddenly there was a new horizon that seemed extremely interesting. Now, of course, for a number of very good reasons, digital photography has quickly become the dominant working method for all types of photographers. It is now possible to produce prints that are extraordinarily beautiful without exposing yourself to photochemistry; and the process is both incredibly flexible and fun, that is, if you enjoy working on images in front of a monitor.

The debate between "purists" and digital converts is the inevitable expression of personal aesthetic preferences more than a fundamental schism within photography itself. Ansel Adams was one of the first to recognize and adopt Polaroid materials, and I'm certain he would be using digital processes if they met his extremely high standards for print quality. As of this writing, artists, curators, collectors, conservators, and dealers have long agreed that the image quality and archival longevity of digital photographic prints qualify them as fine artworks.

But there are many, often contradictory, misconceptions about digital photography that we first have to discuss. On one hand, some people think that digital photography is a hopelessly complex process that only photo-geeks can master.

On the other hand, some of the obvious differences between the digital and traditional approaches give some photographers the impression that learning new exposure and contrast control techniques isn't really necessary—as if digital processes could magically provide instant solutions to some of photography's technical mysteries! Let's take a look at some of these differences and see what they can teach us:

- First, digital cameras give you a small, instant preview of your image, along with warnings about excessive contrast that may be beyond the range of the camera to render. This is like having a tiny, electronic preview which would seem to eliminate the need to precisely calculate your exposure in advance because you can always make adjustments as needed.
- Also, with digital processes, there is no film to develop, and we learned in Chapter 6, "Development," how important it is to be able to use film development times to control the contrast of your negatives to facilitate fine printing.

- Finally, digital processes can move your images into the vast realm of Adobe Photoshop and the almost infinite number of ways it allows you to manipulate and enhance your prints.

But each of these factors contains insights into why it's important to better understand and apply some of the basic principles of the Zone System—although using methods that are unique to digital photography.

For example, higher-end DSLR cameras like the Canon EOS series and the Nikon D300 offer a feature called Live View that simulates the exposure of digital images you are about to take. Live View enabled cameras use what essentially is a video-based image on your LCD Monitor to give you a way to preview your composition and exposure choices. I have found Live View to be a very useful feature, especially when used together with Zone System previsualization concepts and camera raw conversion software discussed later in this chapter.

The problem with relying on Live View for all of your digital exposure choices is that, as you will learn in the section below titled The Problem with Digital Shadows, there are very important technical reasons to intentionally slightly overexpose digital images, but Live View previews might encourage you to instead underexpose for purely aesthetic reasons. The Zone System provides you with a very precise and consistent method for accurately exposing for the highlights in ways that might not feel intuitive when looking at a Live View image on your camera's LCD monitor.

One other very useful feature that some digital cameras offer is a histogram of the previewed image that can serve as a guide for adjusting your exposure. We will discuss how this is done later in this chapter.

Digital camera previews can also be deceptive because those small images are actually altered by the camera's internal software based upon generalized assumptions about the way you will want the image to look. This automatic feature is often helpful, but sometimes it exaggerates problems that are actually easily correctable if you understand how to manipulate the contrast of digital image files.

[**note**] Many digital cameras offer the option of adjusting the settings for how the JPEG preview is displayed. Consult your user's manual for information on how to do this.

Finally, although Photoshop is by far the most powerful and complex image-editing tool ever created for nonscientific purposes, there are practical limits to what you can do to correct digital images that are badly underexposed or have too much contrast and are overexposed. Understanding these limits is essential for getting the most out of your digital work. In this sense, film and digital photography have more in common than you might think at first.

A Word about Structure and Understanding

This chapter has two related objectives. The first is to provide readers with a clear and simple method for obtaining the best possible quality in their digital photographs. The second goal is to provide a broad understanding of the basic technical concepts that underlie digital image processing. These two goals might seem to be the same, but they really aren't.

If you are looking for a general understanding of digital exposure and contrast control so you can get better results, this text is structured so you can read straight through without getting bogged down in the mathematical details of issues such as bit depth and the digital linear effect. (The truth is, unless you're Thomas Knoll, the primary architect of Adobe Photoshop, most of us have only a relative understanding of these things anyway.)

When you get to those sections, you can simply accept my assumptions about what these concepts mean for your work and read on. If, however, you're like me and find that developing some understanding of the more technical concepts is fascinating and important, the text will direct you to appendices that more fully explain these subjects. In addition, Appendix W lists technical source books that will take you as deep into the numbers as you would like to go.

THE AUTOMATIC ALTERNATIVE

Many people new to digital photography quickly discover that they can obtain perfectly adequate results using the automatic metering systems provided by camera manufacturers to simplify the shooting process.

Automatic metering modes work well, but they necessarily compromise the quality of your work in situations in which a better understanding of photo technique would allow for more innovative results. If you look closely at most creative work, you will see that, very often, the beauty and meaning of the work depend on departures from "automatic" ways of shooting. The more you understand the formal and technical principles of digital photography, the more control you'll have over the creative process.

COLOR MANAGEMENT

Unless you're a very experienced digital image editor and printer, it's probably a good idea for you to read Appendix A on the subject of color management before you attempt to apply what you will learn in this chapter. "Color management" is the term used to describe the process of calibrating, profiling, and setting up your system so that your printer produces images that match what you see on your monitor. Many photographers new to digital processes take this step for granted and end up frustrated and waste lots of ink and paper attempting to produce predictable results.

My hope is that the information in Appendix A will resolve all these problems and make the process of printing your work as efficient and straightforward as is possible.

SCANNING

As one of the two ways that photographic images enter the digital world (the other being shooting with a digital camera), scanning is an important topic of this book, especially as it relates to the issues of image resolution, bit depth, and image quality.

However, this chapter will not discuss the problems that result from scanning negatives or prints that are badly underexposed or overdeveloped. Reading the preceding chapters of this book will teach you how to avoid producing unworkable negatives and prints in the first place.

TEACHING APPROACH

As I mentioned in the introduction to this edition, this chapter will not attempt to describe all the many ways that these techniques apply to all the many brands of cameras and applications available. No book could do that, if only because things change so quickly and dramatically in this field.

Instead, what I'll do is stick to fundamental principles that apply to all digital processes and describe how these work with one typical system that I know very well. (See "Basic Assumptions" next.) I call this the "straight and narrow path" to technical education. My experience has been that when you clearly understand how to solve these problems with one camera and operating system, learning how to apply them to your own equipment isn't so difficult.

Basic Assumptions

Let's begin by defining some of the tools, systems, platforms, and preferences upon which this chapter is based.

PLATFORMS AND OPERATING SYSTEMS

In the field of computer graphics, it was once fair to say that Apple Macintosh computers were far superior to PC-based systems. This is no longer true. These days, although artists, graphic designers, and educational institutions still favor Macs, PCs are fully capable of producing results that are just as good as anything done with the Macintosh. And, in fact, because of the dominant position of PCs in the market, certain tools and software applications often appear in PC-based versions before they are available for Macs. It's purely a matter of your preferences which system you choose at this point.

For the purposes of this chapter, I should make clear that my preference is for the Mac, and all the instructions I cite are based on the Apple Macintosh OS X 10.11.5 system, which is the most current as of this writing. The PC-based commands are very similar, so readers using that system should have little trouble finding the equivalents.

APPLICATIONS

As I write this, the most current version of Adobe Photoshop is CC 2017.0.1. I'm also using version 9.6.0 of the Camera Raw utility. Some of the techniques I describe are available only on these versions. I'm also assuming that anyone reading a chapter on digital photography is somewhat familiar with Photoshop's basic functions and tools. Consult Appendix W for references to a number of excellent books on Photoshop if necessary.

DIGITAL CAMERA CHOICES

The digital camera I use now is the Canon EOS 60D, a mid-range DSLR that provides both professional-level features and quality at a consumer-oriented price. Many other digital cameras fall into this category but, once again, all the principles I cite apply in very similar ways to

cameras in this price and feature range. Even some point-and-shoot-type cameras are capable of producing images that will work with these techniques. I will have more to say about this later.

Digital and Film Photography

SIMILARITIES AND DIFFERENCES

When you're working with professional digital SLR cameras, the basic photographic principles relating to apertures, depth of field, shutter speeds, metering, and so on are essentially the same as for film-based photography.

This means that photographers beginning to make the transition to digital imaging don't have to relearn what they already know about basic photography, and that's reassuring. But, as we will see, the fact that these basic photographic principles are being applied to digital media has real consequences when it comes to effective exposure and contrast control techniques.

To better understand how the two approaches compare, let's begin with an overview of the digital and film-based photographic processes.

THE DIGITAL PHOTOGRAPHIC PROCESS

Every photographic frame, digital or film, goes through four basic steps, and each has a dramatic effect on the quality of the final print:

1. ISO Selection.
2. Exposure.
3. Processing.
4. Printing.

Both film and digital photography share these steps, so it's important to understand them. Experienced photographers take each of these steps very seriously and therefore get generally better results. Beginning or casual photographers don't understand the implications of these steps and either neglect or try to automate them, which is why they generally get inconsistent or technically mediocre images in the end.

Using the film-based photographic process as a model, I would like to explain each step's digital equivalent so you can understand why I'm recommending that you make certain decisions about how to expose and process your digital images. I realize that there may be readers of this edition who have never worked with film, and for them, the comparisons in this section will be a bit of history. As I move through these explanations, I'll highlight a number of cardinal rules for digital photography that will give you better results.

[Step 1] ISO Selection

Before you do anything else when taking a picture, it's important to know the sensitivity rating of the media you plan to use. With film photography, we've learned that we have to choose a faster film (higher ISO) if we're planning to shoot under low-light conditions. The trade-off is that faster films produce grainier prints.

Digital photographic processes work in a similar way with two important differences:

1. Digital cameras allow you to change the ISO for each frame you shoot, which gives you much greater flexibility. This can be an enormous advantage.
2. Instead of film grain, using higher ISO speeds with digital cameras adds what's called "noise," or random pixels of either brightness and/or color in the shadow areas of your image.

FIGURE 10.1 Digital noise.

This means that digital underexposure has two consequences that you have to cope with instead of one: As with film, the underexposed shadow areas are too dark and lack detail, but with digital images, you also have to deal with noise in your shadows, which can be unsightly and distracting.

[**note**] The presence of digital noise illustrates one of the key differences between film and digital sensors. Changing the ISO on a digital camera amplifies the signal generated by the camera sensor, but this is not the same as making it more sensitive to light.

For these reasons, the first cardinal rule for digital photography is: Unless you want dark and noisy shadow areas for aesthetic reasons, **with digital cameras always use the lowest ISO that makes sense in a given shooting situation**. The deciding factor is usually the most practical shutter speed.

For many reasons ISO 100 has become the standard, but because digital technologies change rapidly, refer to your camera's specifications to make sure. There are effective software tools you can use to minimize or totally eliminate noise from digital images, but using them can also degrade your image by obscuring fine detail if you don't use them properly. (See Appendix X for a list of helper applications that I recommend.)

[**Step 2**] Exposure

Digital camera light meters behave in essentially the same way as those in film cameras: They both average the brightness of the reflected light they see to an exposure that prints as middle 18 percent gray or Zone V.*

You can test this very easily with a digital camera by shooting three frames one after the other in the following way. (Note that you can also perform this exercise using any camera phone, as illustrated in Figures 5.7–5.9 in Chapter 5, "Exposure.")

- Set your camera to one of its automatic metering modes, entirely fill the viewfinder with an evenly lit very dark surface, and shoot the first frame.
- Using the same automatic metering mode, completely fill the second frame with a middle gray surface and shoot it.
- Automatically meter and shoot the third frame filled with a very light surface.

When you look at the previews of these three frames, you will see that they're very close in value and only the second frame actually looks like what you shot.

[**note**] To complete this little exercise you could shoot a frame that is half filled with light and dark surfaces. Both will be properly exposed. The broader implications of this effect are spelled out in Chapter 5.

Although digital and film camera meters behave in the same way, because of fundamental differences in the way that digital chips measure light, the basic rules for applying the Zone System to digital photography are the opposite of those for film.

The second cardinal rule for digital photography is: **Expose for the highlights and process for the shadows.**

This is just the opposite of the classic Zone System rule for film photography, where the rule is: Expose for the shadows and develop for the highlights. I fully explain why this is true in the later section "The Zone System of Digital Exposure."

** To be more precise, all light meters are actually calibrated using ANSI standards to produce images that are 12 percent gray or 1/2 stop less that the 18 percent gray you see in Kodak Gray Cards; see www.bythom.com/graycards.htm.*

[Step 3] Processing: Camera Raw

After you expose a frame of normal photographic film, the image first exists in what's called an invisible "latent" state. All the subject's brightness values are captured and are encoded in the emulsion, but they aren't visible until after the film is "developed" in the three baths called Developer, Stop, and Fixer. After development, the visible image is fixed in the negative and there isn't much you can do to change it.

I know that all this information is familiar and perfectly obvious to most readers of this book, but I'm overstating it to make the point that, conceptually, a very similar process applies to digital photography, and this has profound implications for how you should work with digital images.

After you expose the digital camera sensor to light from the subject, the image first exists in a latent state known as "Digital Raw," which contains visual information that can't be seen until the image has been processed or "converted" into a form that can be viewed on a digital monitor, either as the small preview on your camera, or as the image you see on your computer screen.

The development or conversion process is done electronically, and if you don't preserve this raw image, all the information it contains is lost forever. This would be like throwing away your negative after making your first print.

So, another fundamental difference between digital processes and film is that the unprocessed, digital latent or raw state of the image can be preserved even after the image has been processed (converted). Latent film images are always lost when the film is developed.

Just as with film photography, you can easily tell the difference between unconverted and converted digital images: On your computer screen, you see raw images as generic icons with extensions like .nef, .crw, or .dng, which stands for the universal standard "Adobe Digital Negative." The reason the raw image icon is generic is that, unless your operating system has a built-in raw converter, your computer has no idea of what the unconverted image looks like; just as with film if it were possible to see an undeveloped frame with visible light.

The developed or converted form of the image has a thumbnail image icon and an extension like the familiar .jpg, .tiff, or .psd for images that have been converted into Photoshop files.

Photographers new to the digital world are often confused about this step because the conversion actually happens twice and in different ways in the digital process. The first time the image is converted is in a generalized way by JPEG compression into the thumbnail you see on the camera's small screen. This preview is based on default settings built into the camera and is only a rough approximation of the second, more refined conversion you can do after the image has been downloaded to your computer.

But the point remains, digital images can exist in two distinct states—raw and converted—just like undeveloped and processed film. The differences between these two states is extremely important to understand because raw digital image files contain vastly more visual information than the converted state, especially when the conversion is into the popular JPEG format used by many photographers and applications.

JPEG-formatted images are compressed and processed into a form that is typically two to four times smaller than the raw file of the same image, so it can never make a print that is as large with the same quality.

The raw digital image not only has much more visual information, but also has information called "metadata" that records things like the exposure you used, the focal length of the lens, and the ISO used. Some cameras are even equipped with GPS software that allows you to know precisely where and when the image was taken!

[**note**] JPEG images also have metadata, but because the image is so compressed, this is much less useful.

These days the advantages of shooting in raw format are becoming common knowledge for photographers and there are even smartphones that can capture raw images. The iPhone 7 Plus is a recent and very good example of a smartphone that captures in a raw format* and, with its 12 megapixel sensor, generates image files that produce large and beautiful prints. But there are still many new digital photographers who either inadvertently buy cameras that don't offer the raw format as an option, or they convert their images to JPEGs and throw this information away without realizing what they are doing. If nothing else, you should make a practice of archiving the raw version of your best work, just as you would your negatives.

The vital point to know is that, if you choose to shoot your digital images in JPEG format, the conversion and compression happens immediately, and this information-rich raw latent image is instantly erased.

This gives us our third cardinal rule for digital photography: **Always shoot in raw format unless you are certain that you will never need the visual information stored in the raw digital file.**

It's true that shooting in the raw format gives you fewer images per storage card or disk, but because you will never have to buy film for your camera, it's economical to buy a larger storage media and convert your images to JPEG format if you need to later.

[Step 4] Printing

There are profound differences between the digital and analog photographic printing methods. Digital inkjet printer manufacturers strive to make the prints from their products match the quality of fine color and black-and-white silver-based prints, but there will always be differences that are obvious to experts. Whether one is qualitatively better than the other is something that will always be debated, but this clearly has more to do with the aesthetic skills and vision of the maker than anything else.

There are also some important formal process issues that, for many of us, make digital photographic printing an exciting advance over traditional printing.

** As of this writing, MAC OS 10 that runs on the iPhone 6 and up will allow third-party applications like Adobe's Lightroom Mobile and VSCO Mobile to implement DNG format capture and editing. I would not be surprised if, by the time you are reading this, the iPhone camera itself will capture DNG images.*

When you create an analog print in the darkroom, part of the mystique and challenge is that you have to train your body to precisely reproduce the pattern of hand movements required to burn and dodge the print properly. If you are able to do this once, perfect; it is very difficult to do that again. This has the result—for some, the benefit—of making each analog print unique. However, fine printers often feel that there is only *one* special print that is absolutely perfect. Often at this point the artist is exhausted and has to struggle to retrieve the precise choreography of hand motions that are required to return to that magical stage in the process.

When you are working on fine printing a digital image in Adobe Photoshop, you still have to work hard to achieve this ideal rendition, but when you're done, the image stays at that level of resolve until you are ready to print it or push it further. This, in many ways, is a degree of control and refinement that serious photo-artists have always wanted. But, of course, all this assumes that three crucial elements in the process are in place:

- First, all of the technical components of your system (software, monitor, printer, etc.) have to be well calibrated and fully functional.
- Second, you need to have a clear understanding of the relevant concepts and processes involved.
- And finally, you need the aesthetic judgment and vision to place all this into effective motion. The purpose of this chapter is to help provide the first two of these factors.

Although it's true that in purely formal terms you can produce effects with digital printing processes that would be difficult or impossible to reproduce in a darkroom, I firmly believe that it's important for photographers to internalize the skills that come from using your hands and body in a traditional darkroom before devoting your time to digital printing. But then again, I know that this is a bias that's tinged with nostalgia. It will be interesting to see how photographers who are just beginning respond to developing their aesthetics in a purely digital environment. My guess is that digital photography will simply be another tool that expands rather than radically reforms the way artists use it to express themselves.

DIGITAL PRINTER QUALITY

All considerations of digital printing, of course, depend on the type and quality of the actual machine you use to create the final print. In recent years, inkjet printing technologies have improved to the point where it is now possible for companies in the business of producing digital advertising layouts to use professional inkjet printers for the critical step of prepress proofing that requires extremely precise color rendition. Printers of this type are essentially the same as the printers that photographers can now own for their personal digital studios.

I currently own an Epson Stylus Pro 4900 printer, and the quality of the prints I can create is remarkable.

[**note**] See "Other Useful Digital-Related Sites" in Appendix X for information on the maintenance of these printers, especially as this relates to the problem of clogged nozzles.

Other Digital Printing Considerations: Large-Scale and Banner Printing

One of the key advantages of digital photographic printing is the option it offers to create prints that are far larger than could be printed in the average traditional darkroom. One of the great joys of visiting Ansel Adams's home darkroom in Carmel was to see the massive horizontal enlarger he used to make large-scale fine black-and-white prints. Black-and-white mural printing requires great skill and special darkroom layouts. Color mural printing requires a profitable business to support the equipment and chemistry needed. In contrast, professional-quality inkjet printers that make beautiful black-and-white or color images up to 44 inches wide are available as of this writing for under $5,000.

In most major cities, it's possible to find commercial digital printing labs capable of printing digital files up to 72 inches or larger. The key to printing this way successfully is knowing how to properly prepare your file through interpolation in Adobe Photoshop using the Bicubic Smoother (best for enlargement) setting inside the Image Size command box and understanding the quality limits of digital printing. I'll have more to say about the Image Size box in the later section on digital scanning.

The other advantage of digital printing is the ability to create artworks in banner or scroll format with prints as long as you need them to be. I, for example, have prints in my portfolio that are over 6 feet long. Printing these using traditional methods would be prohibitively expensive.

Pixels: Size, Resolution, Bit Depth, and Quality

The representational power of digital photography begins with individual picture elements called "pixels." If you enlarge any digital image enough, you will see that the apparently continuous tonalities of the image are actually created from these tiny individual image tiles.

And yet, despite how familiar we are with the general idea of pixels, there is still a lot of confusion about what they actually are.

There are four essential points you need to understand about pixels, and each has important implications for the quality of digital photographs:

1. There are two general types of pixels: fixed-sized **hardware pixels** and variable-sized **image pixels**.
2. When there are **200** or more pixels per inch in an image, your unaided eyes can't see them.
3. Although image pixels can be almost any size, from fractions of an inch to many feet across, in black-and-white digital images each pixel can be only **one individual tone of black, gray, or white**. **In color digital images, each pixel can be only one single color.**
4. Although each individual pixel in an image can be only one tone or color, the number of different tones or colors a pixel is allowed to be can be vast!

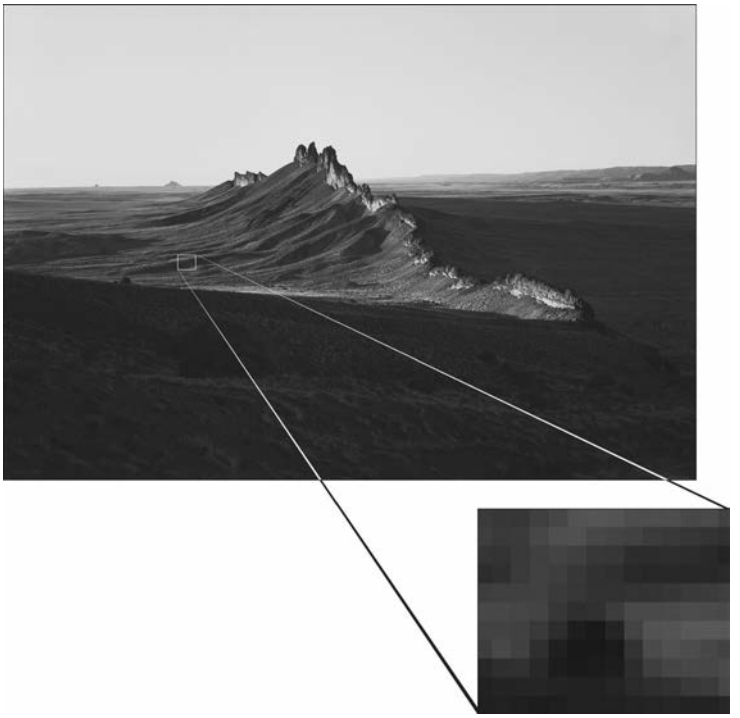

FIGURE 10.2 Digital image pixels.

To visualize what I mean by this fourth point, imagine that two children are asked to fill in an empty square outline with one color from a box of crayons. Because this square is equivalent to a pixel, each child can use only one color to fill it in.

The difference I'm referring to is equivalent to one of these children having a box with only 10 crayons in it, whereas the other has 500. Clearly, the second child has many more and subtle colors to choose from and a great aesthetic advantage. This difference in the range of available color choices is referred to in digital photography as differences in "bit depth."

Low Bit Depth.

High Bit Depth.

Much more on this later.

HARDWARE PIXELS AND IMAGE PIXELS

Hardware pixels are physical things built into digital sensor chips, computer monitors, scanners, and inkjet printers.

The function of hardware pixels is to gather, display, and reproduce the visual information that we see as **image pixels**.

- For example, in a digital camera, the image sensor that takes the place of the film is covered with hardware pixels called "photosites" that actually capture the image that passes through the camera lens.
- On the surface of a computer monitor, a "pixel" is a fixed and rigid physical entity that can never change size. The resolution of monitors is set to values like 96 or 110 pixels per inch. Retina Displays have 200 to 326 pixels per inch. Whatever the resolution of display monitors, this pixel count always remains the same. But keep in mind that these "monitor pixels" are only the tiny dots that actually create the "image pixels" you see on the screen.

When the screen is displaying a digital image, these "screen pixels" are used to create "image pixels" that can be almost any size depending on how many screen pixels comprise them. For example, when one screen pixel is used to reproduce one image pixel, the image display in Photoshop reads 100 percent, or "Actual size." When two screen pixels are used to display one image pixel, the image shrinks to 50 percent.

Another example of this relationship between fixed and variable image pixels would be the physical holes in the print heads of inkjet printers that spread minute clouds of pigment on paper to reproduce the image pixels we see in prints. (See Appendix C for more details about pixel size relationships.)

RESOLUTION AND BIT DEPTH

When a digital photograph is either displayed or printed, the number of pixels per inch that you see is defined as the image's "resolution." This is one key factor that determines a digital image's quality. For example, if there are 300 pixels in one inch of an image, we would consider that to be a high-quality image. Recall that in the "Pixels: Size, Resolution, Bit Depth, and Quality" section we stated in point #2 that 200 pixels per inch are enough to fool your eye that there are no pixels present at all. If there are only 10, we would say the image quality was very poor. Much more on this topic shortly.

The number of different tones or colors that a pixel is allowed to be in a digital image is a measure of what's known as the pixel's "bit depth." This is another key determinant of a digital image's quality.

As you will see from the following examples, learning how to optimize both the resolution and the bit depth of an image's pixels are important skills for digital photographers who want the most from their work.

THE QUALITY OF DIGITAL IMAGES

It's always a little ironic when someone looks at a fine digital print and says that it looks just like a "real" photograph. In all the ways that matter the most, even a portrait of your child in your iPhone is a real photograph.

FIGURE 10.3 High-quality digital image.

FIGURE 10.4 Low-quality digital image.

But, of course, what comments like this really mean is that digital technology is doing exactly what it hopes to do—that is, translate a purely electronic digital file into what appears to be a full-fledged, continuous tone photographic image.

In purely technical and very general terms, most digital photographers would agree that Figure 10.3 is an example of a "high-quality" image, and Figure 10.4 is an exaggerated "low-quality" version of the same photograph.

To better understand the differences between these two images, let's translate them into aesthetically neutral gradations that represent the tonal values in each photograph.

FIGURE 10.5 High-quality digital gradation.

FIGURE 10.6 Low-quality digital gradation.

Using these two gradations as examples, we can now say that what digital photographers mean when they speak of "image quality" is the goal of *reproducing smooth, gradually continuous gradations that are typical of analog imaging media like film.*

For reasons that will soon be clear, Figure 10.6 has noticeable steps in the transitions from one tone to the next. The more smooth and seamless the transitions are from one tonal value to the next, the higher the image quality is said to be.

Given what we learned earlier about the way pixels seem to disappear when there are more than 200 of them per inch, you might think that only small pixels (high resolution) are enough to achieve a smooth gradation. The following example will illustrate why both resolution and bit depth are needed to determine the quality or smoothness of the gradations shown in the preceding figures.

Imagine that each pixel in the preceding gradations is a step in a flight of stairs. The "resolution" of the staircase would be a measure of the *number* of steps in each staircase. The actual size of each individual step (pixel) is the factor; the smaller the step is, the more of them there are and the more smooth the gradation.

But keep in mind that although the size of each pixel (step) can change, it can still be only one tonal value. In this case, each pixel is limited to one of only 10 different tonal values.

This concept can be illustrated as shown in Figure 10.7.

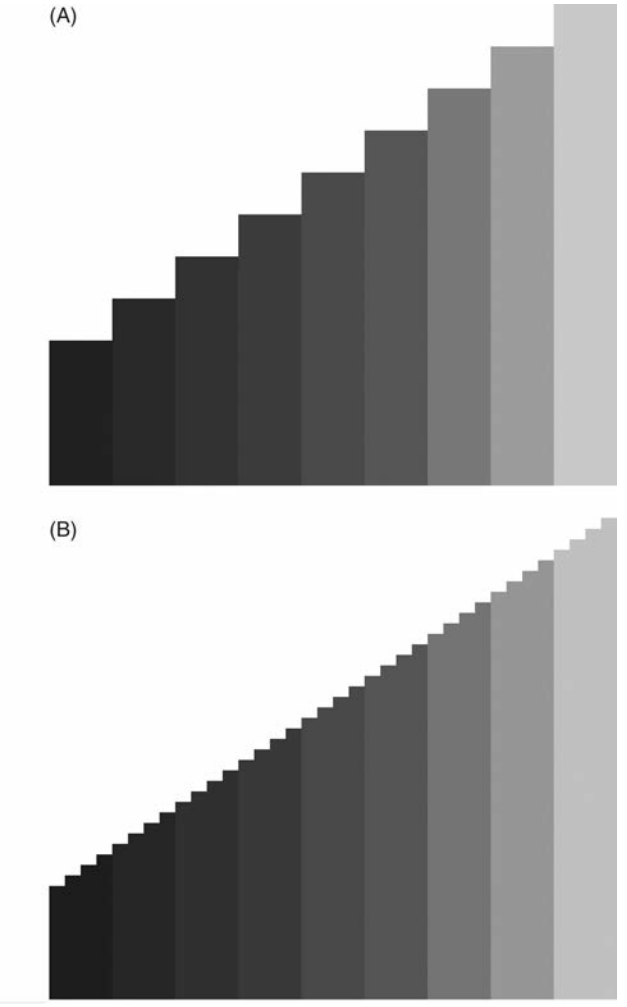

FIGURE 10.7 (A) Low resolution/low bit depth; **(B)** High resolution/low bit depth.

Notice that by greatly increasing the resolution of Figure 10.7B, its slope is much smoother. It has much smaller pixels (steps), but the gradation itself is still not continuous because the number of individual tonal values that each step is allowed to be in this illustration is still limited to 10. This is like the child who had only 10 crayons in her box in the earlier example.

Remember that we defined bit depth as the number of different tonal values (also known as "levels") that each pixel is allowed to be in a given image. With this definition in mind, we could say that Figure 10.7B is an example of a high-resolution but low bit depth image.

Increasing an image's bit depth allows each pixel to be more levels of tonality. If we were to optimize both the resolution and the bit depth of this illustration, the result would look like Figure 10.8.

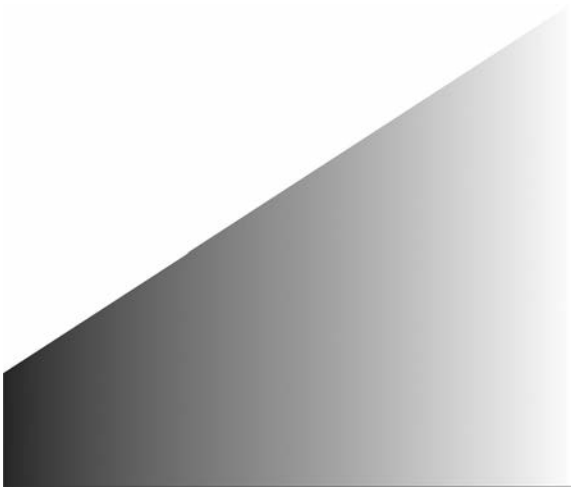

FIGURE 10.8 High resolution, high bit depth.

The reason this gradation is smooth is that the number of steps is very high (in other words, it has high resolution), and the number of different tones each step is allowed to be is also high (high bit depth). What this illustration makes clear is that learning how to optimize both a digital image's resolution and its bit depth is important for achieving the best quality in your work.

Optimizing Digital Image Resolution

Pixel editing software makes it possible to radically alter many characteristics of digital images, which include the size and color of pixels and your image's contrast and sharpness, along with many other variables.

In this sense, *bit depth* and *resolution* can be considered **core digital values** because the only time it's possible to establish these qualities is when the image is captured, by either a digital camera or a scanner. The reason is that bit depth and resolution are functions of the amount of memory your scanner or digital camera commits to actually gathering visual information from your subject. To use the crayon analogy one more time, you need a larger box (more memory) to hold a larger number of crayons (bit depth and resolution). The point here is that when the subject is out of sight, it is no longer possible to change either the core resolution or bit depth of your image.

[**note**] The other technical factors that influence the quality of a digital image include the quality of the sensor and the analog-to-digital converter built into the scanner or camera.

Digital editing software provides you with very tempting options for increasing the virtual (as opposed to the actual) resolution and bit depth of digital images if you discover that the resolution is too low after your image has already been scanned or captured. This is called "interpolation."

The problem is that when you interpolate, you are asking the computer to mathematically simulate visual information that it can't actually see. Over recent years the algorithms used by digital editing software have dramatically improved, but if interpolation is pushed too far, this will result in a noticeable loss of image quality.*

Understanding how to optimize a digital image's resolution begins with having a very clear idea of how you ultimately intend to display your photograph. The ideal resolution for an image that will be displayed on the web is very different from one that you intend to print with an inkjet printer. The more thought you give to this decision at the beginning of the process, the more you are likely to avoid painful choices in the end.

For this reason, our next cardinal rule is: **Capture or scan at resolutions and bit depths based on the type and ultimate size of your final image and don't interpolate unless it can't be avoided.**

There are only two ways of bringing photographic information into the digital realm: digital capture or digital scanning. Digital capture means that you are using a digital camera to directly translate the visual world into digital information. Digital scanning assumes that you already have a film negative, slide, or print that you want to manipulate with digital processes. In both cases, you need to understand how to optimize your bit depth and resolution.

OPTIMIZING BIT DEPTH THROUGH DIGITAL CAPTURE

Earlier when discussing the difference between shooting in Camera Raw format and JPEG, I emphasized the fact that raw format images contain vastly more visual information than compressed JPEGs.

Now that I've defined some of these terms, I can further say that when you shoot in Camera Raw format, your images will automatically have the high bit depth you are looking for to optimize the quality of your digital photographs. And, in fact, **this is the only way that you can obtain high bit depth images through digital capture**.

In Appendix D, I discuss some of the arithmetic behind the terms "high" and "low" bit depth. This underscores why it is so important to shoot your digital images as Camera Raw formatted files before you then convert them into any of the processed formats that you require: .psd, .tiff, or .jpg.

OPTIMIZING RESOLUTION THROUGH DIGITAL CAPTURE: PIXEL COUNT AND PRINT SIZE

When you remember once again that it takes only a minimum of 200 pixels per inch to fool your eye into believing that it's seeing a continuous toned gradation, it becomes easier to understand why digital photographers are concerned with the resolution or pixel count of the cameras they buy. Here's how this works.

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* *This principle applies only to bitmapped or rasterized images that are made from image pixels. Vector-based images can be scaled to larger sizes without a loss of quality. (See Appendix Y for definitions of these terms.)*

If your goal is to make the largest possible, high-quality (meaning photorealistic) digital print, the rule is: **The greater the number of pixels your camera can capture, the larger the print you can make.**

The "resolution" of a digital camera's image sensor is defined as the actual count of the individual "photosites" (pixels) on the surface of the sensor. When a camera lists its resolution as 10 megapixels, this means that if you multiply the number of tiny photosites in the horizontal and vertical dimensions, you get the total number of photosites on the sensor.

For example, imagining that Figure 10.9 is the image sensor of a typical digital SLR, if the manufacturer designs the sensor so that there are 3,872 photosites in the horizontal dimension and 2,592 in the vertical, the total number of photosites would equal 10,036,224 pixels. This would be called a "10-megapixel sensor."

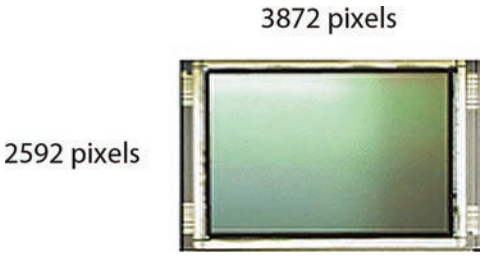

FIGURE 10.9 The dimensions of a 10-megapixel digital image sensor.

So the question is: How large a print can you make if you have approximately 10 million pixels to work with from your digital camera?

Here are the factors to consider. If your goal is to create an image that is photorealistic and you're using a high-quality inkjet printer, then the standard number of pixels you need would be 300 pixels per inch. In this case, 200 pixels per inch are enough to render what seems to be a continuous gradation, and the extra 100 are added for good measure.

Starting with the image sensor's long dimension of 3,872 pixels, if you divide this number of pixels by 300 pixels per inch, the result is a print that is about 13″ × 8.6″, keeping the proportions of the image the same.

FIGURE 10.10 Pixel count and final print size at 300 pixels per inch.

You can now understand why professional photographers often work with digital camera backs that capture up to 80 megapixels. With that many pixels, you could make a large inkjet print without interpolation.

So, the key to optimizing resolution in digital capture is to understand the size of the prints you intend to create and use the formulas just described to purchase a camera with the appropriate resolution.

OPTIMIZING RESOLUTION AND BIT DEPTH THROUGH DIGITAL SCANNING

Digital scanning assumes that you already have a film negative or slide to work with, which means that eventually scanning could be a highly specialized or lost art. But for now, using a virtual drum scanner, like the Hasselblad/Imacon Flextight scanner described below, to produce high-resolution scans from fine-grained color films remains a key way to create extremely high-quality digital image files. For example, if you were to use an Imacon scanner to scan fine-grained medium to large format film, you could end up with the equivalent of a 200 megapixel digital image. This is more resolution than you can currently get from a Phase One digital back costing well over $30,000.

Also, learning how to optimize a digital scan presents you with an ideal opportunity to learn how to control the core values of resolution and bit depth. Scanner interfaces present you with opportunities to actually decide on settings that determine the resolution and bit depth of the resulting digital image. By looking closely and working with digital images from scans, you can see right away the consequences of making wrong choices.

Scanner types fall into categories defined by the material they are designed to digitize and the level of quality they can produce. It is also vital to understand the difference between the *actual optical resolution* capabilities of a scanner—in other words, the amount of information it can literally see, as opposed to the *virtual* or advertised resolution of the scanner, that is, the amount of information it can fake through interpolation. Read the scanner's specifications carefully and always use a scanner's optical resolution as your standard. Avoid interpolation unless you have no other choice.

[**note**] Adobe Photoshop's interpolation technology has improved to the point where you can do minor upsampling without noticeably degrading your image. However, if you decide that major increases of your image's file size are necessary, consider using special applications designed for this purpose. (See Appendix X for Photoshop-related applications.)

Dedicated Film Scanners

Dedicated film scanners are designed to produce high-quality scans of 35mm film. You should always scan at no less than 4,000 dots per inch (dpi) and set the scale size to 100 percent. Anything more than these settings is interpolation. This process will result in an image that has 4,000 dpi resolution but is tiny: 1″ × 1.5″ (this is 100 percent of the size of a standard 35mm frame). But remember that you can always redistribute the scanned pixels to end up with a larger image using Photoshop's Image Size command. The trick is to uncheck the Resample Image box as illustrated later.

Medium and Large Format Scanners

There are three types of larger format scanners: **professional drum**, **Hasselblad/Imacon Flextight**, and **flatbed** scanners. Drum and Flextight scanners always produce higher-quality scans, but they aren't always essential for digital photographers working with current inkjet printers.

Earlier, we discussed the direct relationship between the resolution of your digital file and the size of the high-quality print you can produce. With this is mind, you can easily understand the key advantage of drum scanners. Scanners of this type are capable of producing digital image files of up to 11,000 dpi, but this is often much more resolution than the average digital photographer will need. The two disadvantages of using drum scanners are that they cost from $16,000 to $65,000, and they usually require that the negative or slide be wet mounted to the drum. If this procedure is not done carefully, there is the possibility of damaging your film.

Hasselblad/Imacon Flextight scanners are relatively less expensive, but because they cost around $12,000, most photographers will rely on the services of commercial digital labs to produce scans of their work.

Professional-quality flatbed scanners are currently priced well within the means of most photographers, and they have the advantage of being able to scan film negatives, positives, and prints and documents. For this reason, the next section of this chapter will outline the steps for producing optimal digital scans using software and scanners that are standards in this field: Adobe Photoshop CC 2015.5 and an Epson Perfection V700 Photo Scanner.

The Scanning Process

As I demonstrate the steps involved with the scanning process, I will emphasize how the core digital values I described previously apply to the settings I'll use as I go along.

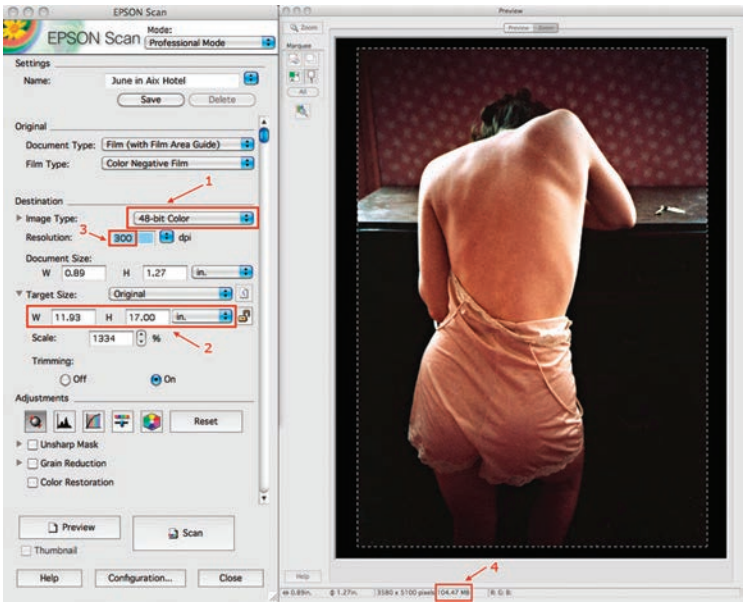

FIGURE 10.11 Optimal flatbed scanning.

In Figure 10.11, my intention is to make a 12″ × 17″ inkjet print of this image, but we will use this scanning illustration to learn what's involved with creating optimal scans for a variety of different uses.

1. **Bit Depth.** Notice that I have set the bit depth to "48 Bit Color."

[**note**] The number 48 means that each of the three color channels—Red, Green, and Blue—will contain 16 bits of visual information. 16 × 3 = 48. More on this later.

This setting will create a digital file with the highest bit depth possible with this scanner. As you will learn later in the section "Bit Depth and Digital Exposure," having the maximum number of pixel levels will allow me to edit the contrast of this image without compromising the quality of the resulting print.

[**note**] When you shoot your work in the Camera Raw format, you're also creating high bit depth images that maximize the number of brightness levels in your image.

2. **Output Size.** It is essential that you set the Output setting to the largest size print you ever intend to make. It's always possible to downsample your digital image file to a smaller size without losing quality, but scaling it up through interpolation will degrade the image.
3. **Resolution.** Scanners often display their resolution settings in terms of dots per inch (dpi). This is in recognition of the fact that nothing is more important than sending an ideal digital file to your printer!
   - **Optimal Resolution for Inkjet Prints.** The minimum resolution you should consider for fine digital prints is 240 dpi. The standard scanner resolution setting for digital prints is 300 dpi, although some say that 360 dpi is ideal.
   - **Optimal Resolution for the Web.** If the only place you plan to display your image is on a computer monitor—for example, if your image will appear only in a web browser—there is no reason to scan at a resolution higher than 72 dpi, the fixed pixel size of computer monitors.
   - **Optimal Resolution for the Print World.** The major stock agencies are setting the standards for professional scans intended for A3 or double page-spread printing. The scanning resolution they require for this is 300 dpi.

Just as important, these companies are requiring incoming images that they represent to have a minimum file size, 30 megabytes for one example, and that these images have only 8 bits per channel and not be interpolated.

The meaning of the words "8 bits per channel" will be discussed very shortly.

To meet this requirement, digital stock photographers are using digital cameras with at least 18 megapixel sensors, shooting in raw format if they intend to edit the images and then reducing the image's bit depth to the 8-bit per channel minimum standard.

[**note**] Professional-quality inkjet printers now come with 16-bit print drivers that take full advantage of Adobe Photoshop and the Apple Macintosh OS X operating system's 16-bit workflow. The result is more accurate image transitions and gradations.

4. **File Size.** Notice that the settings I've chosen for this scan will result in a file that is just over 100 megabytes in size. Ultimately, this is the most important number in this example! Below explains why.

Pioneering child psychologist Jean Piaget is famous for creating a test of cognitive development that uses two cubes of clay that are exactly the same size and shape. Most children will readily say that they are the same. But if you then flatten one cube until it covers a wide area, children below a certain level of development will claim that because you have radically flattened one dimension, the cube contains less clay. A similar principle applies to the way digital images can be resized without losing their quality. The visual quality of any image you create is always determined by the combination of three variables:

1. Resolution.
2. Bit depth.
3. Pixel dimensions.

This last variable is usually expressed with two sets numbers: the actual number of pixels in the horizontal and vertical dimensions and also the "file size"—in other words, the total amount of memory that contains the visual information you have captured or scanned.

When it comes to determining the quality of a digital image, no single variable is ultimately more important than all three taken together. This means that, as long as you have followed the cardinal rules I outlined earlier, you can manipulate these variables without compromising your image quality. Adobe Photoshop has a feature called the Image Size command box that is designed to make this process easy to apply. The following is an example of how this works.

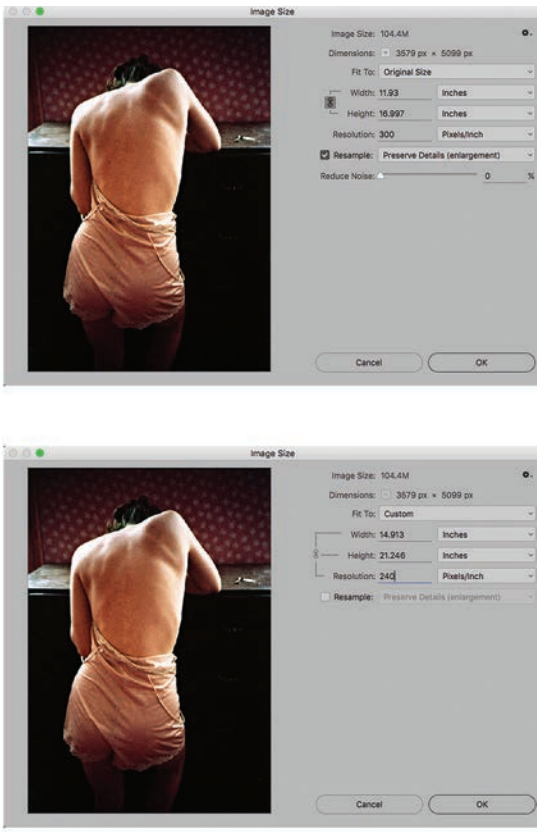

FIGURE 10.12 Using the Image Size box to redistribute pixels.

For the image in Figure 10.11, my goal was to create a fine inkjet print that was approximately 12″ × 17″. Figure 10.12A shows Photoshop's Image Size box for this scan.

Figure 10.12B shows the Image Size box that would result if I later changed my mind and decided that I wanted to make a larger print without compromising the quality of my photograph. Notice that I've changed the resolution to 240, the minimum for high-quality inkjet prints, but the total file size

is the same, 104.4 megabytes. The difference is that each image pixel in the larger print will be a little bigger.

The Resample Image box tells Photoshop to mathematically create new pixels to replace the original ones in your image. Because that box is not checked, the same amount of information is simply distributed in different ways.

If, instead, I decided after the fact that I wanted a larger image, I would use the Image Size box as shown in Figure 10.13.

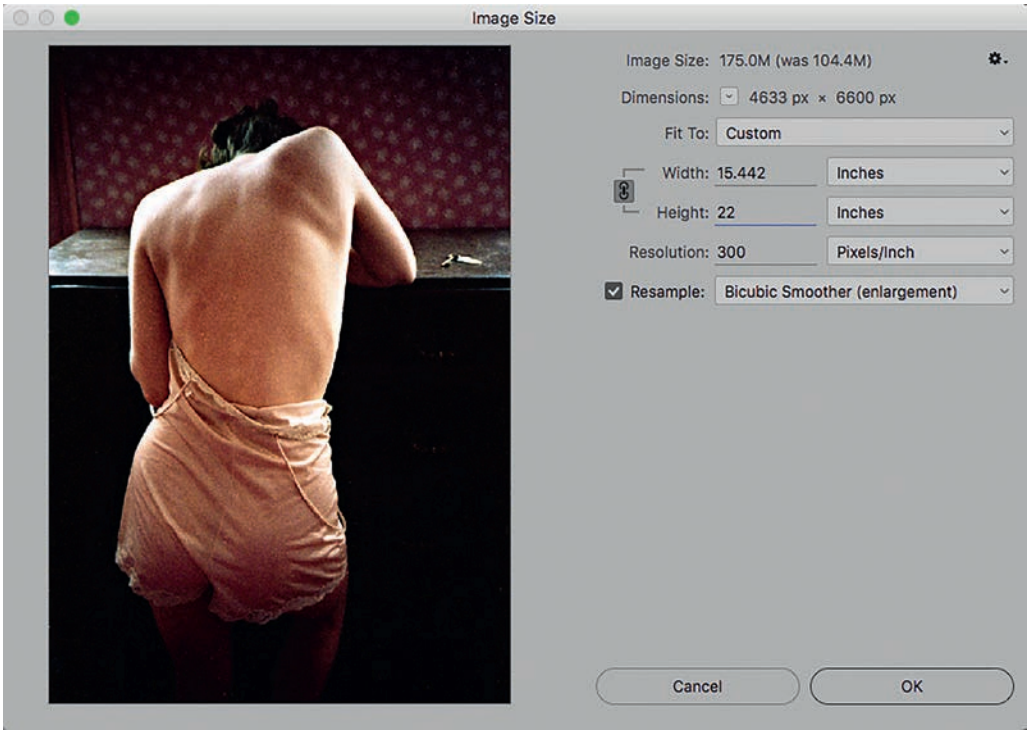

FIGURE 10.13 Using the Image Size box to upscale an image.

Notice that I've checked the Resample Image box. This tells Photoshop that I want to change the file size of this image. Next, I changed the interpolation drop-down menu to "Bicubic Smoother (enlargement)". This is the setting recommended for creating larger images from a given number of pixels.

Notice that the size of the file increased from 104.4 megabits to 175 megabits. Also notice that the image changed from approximately 12″ × 17″ at 300 dpi to approximately 15.5″ × 22″ at 300 dpi. This small amount of interpolation would hardly be noticed, but, as a rule, it's always best to avoid increasing the size if you can.

File Size Calculator

It's sometimes necessary, or just interesting, to know what total file size will result from a given combination of image settings. Adobe Photoshop has a feature that essentially functions as a file size calculator; it instantly accounts for all the variables we've been discussing.

In Photoshop, if you select File > New, the box shown in Figure 10.14 will appear.

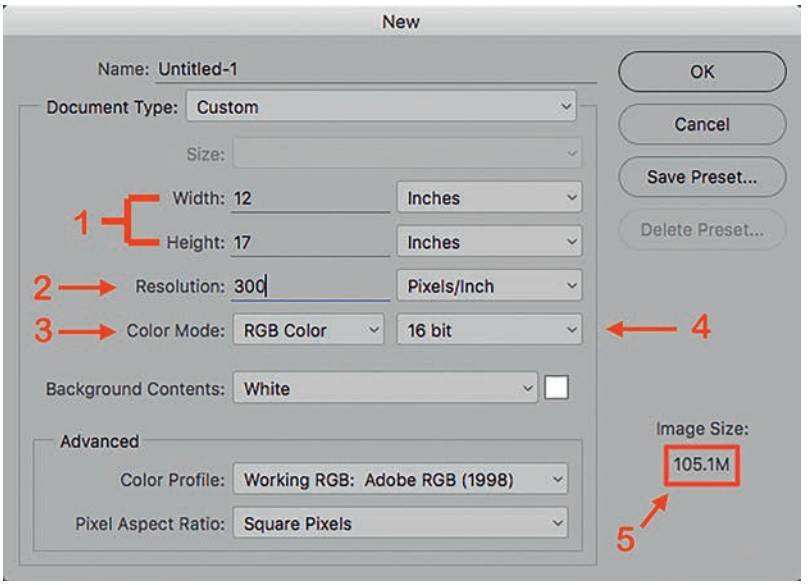

FIGURE 10.14 Adobe New box as a file size calculator.

Notice that all of the image quality settings are present.

1. These are the dimensions of the largest print I plan to make from this file. The drop-down menu also gives me the option of displaying this as the equivalent number of pixels.
2. The standard resolution for high-quality inkjet prints is 300 dpi. Other possible choices are 240 and 360.
3. This setting shows that I will have three color channels in this image.
4. Using 16 bits per channels will allow for editing without degrading the image. When this file is ready to print, I would change the mode of this image to 8 bits per channel, which would reduce the file size by 50 percent. There's no quality advantage to sending more than 8-bit files to the printer.
5. This is the total file size that results from these settings.

Guidelines For Fine Digital Printing

Pixel resolution, bit depth, and the image's total file size are core digital values that together determine the quality of the final print you can make from a given digital image file.

The following guidelines will ensure that the quality of your work is as good as it can possibly be.

1. Always carefully consider the ultimate goal of your project.
   - If your intention is to make a fine inkjet print, the key factor to consider is the size of the largest print you plan to make.
2. Always capture your images at the highest bit depth possible to facilitate image editing.
   - For digital cameras, this means shooting in your camera's raw format.
   - For scanned images, this means choosing the highest bit depth allowed by your scanner.
3. Always scan your image at the resolution that is optimal for the final result you are intending.
   - For inkjet prints, this should be 240, 300, or 360 dpi.
   - For offset printing, this is 300 dpi.
   - For web-based images, 72 dpi is sufficient.
4. After you have edited your high bit depth image, you can reduce it to 8 bits per channel before sending it to your printer, although, as noted previously, 16-bit workflows are now possible.

Learning how to appropriately maximize the resolution and bit depth of your images is important, but we now need to consider the role that proper exposure plays in this process.

Bit Depth and Digital Exposure

It's often hard to believe that beautiful digital prints are ultimately created from numbers that could just as easily be printed out in undecipherable rows and columns. Nothing demonstrates this fact more clearly than the issues of bit depth and exposure with digital cameras.

Earlier in this book, we learned how the Zone Scale functions as a bridge between the meter numbers we use to measure subject values and contrast, and the tonal values of fine photographic prints. In digital photography, the same role is played by something called the histogram.

UNDERSTANDING HISTOGRAMS

Recall that bit depth is a measure of the number of different tonal values that a pixel is allowed to be in a digital image file. The more distinct tonal levels there are in an image, the more photorealistic it will look. But it has been demonstrated experimentally that using only 200 individual tones is enough for human beings to believe that they are looking at a continuous-toned reproduction. This is like saying that if a mural artist were given a massive pile of little tiles and that each had one of 200 different tones, she could create an image that looked like Figure 10.15.

FIGURE 10.15 Digital image with adequate bit depth.

If, however, she were given tiles that had only 100 different tonal values, she would have to make a mural that looked like Figure 10.16.

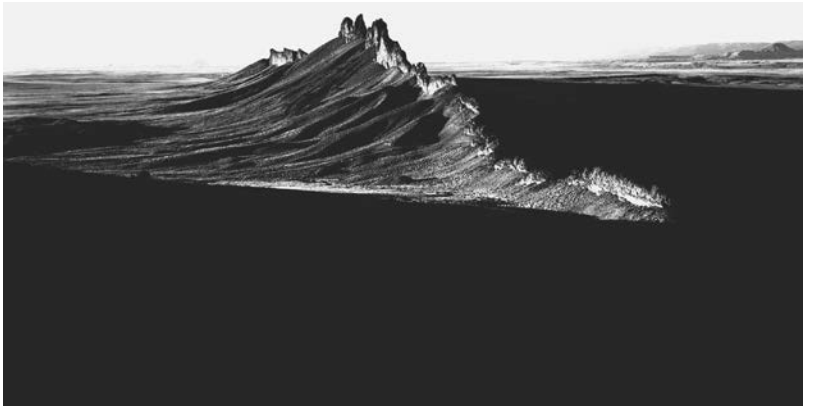

FIGURE 10.16 Digital image with low bit depth.

The harshness and lack of subtlety in Figure 10.16 is the result of the limited number of pixel tonal levels in the image.

This example leads directly to the question of how bit depth is accounted for in digital photography. For most digital editing purposes, the minimum standard for quality is what is called an "8-bit" image, where each pixel can be any one of 256 tones from black to white. (See Appendix D for an explanation of what "8 bit" means numerically.)

In Adobe Photoshop histograms, these individual pixel tonal levels are numbered from 0 for the blackest possible pixel to 255 for pure white pixels. This, again, is like having a choice of 256 values of tiles to choose from when you are building a mosaic mural.

The pixel levels in digital images are organized into layers that are called "channels." An 8-bit black-and-white image has one channel called "Gray" with pixels that can be any of 256 different levels of tone.

FIGURE 10.17 8 Bit Gray channel with 256 pixel tonal levels.

Color digital images have three channels—Red, Green, and Blue—that are combined to create mixed colors. In 8-bit color images, each of these channels also has pixels that can be 256 levels of the red, green, and blue colors. This adds up to about 16.7 million different color possibilities (256 × 256 × 256 = 16,777,216).

With 16-bit RGB color images, when you multiply 65,536 tones per channel times three channels (red/green/blue), you end up with a total of over 281 trillion possible tones for each pixel (65,536 × 65,536 × 65,536 = 281474976710656)!

FIGURE 10.18 16 Bit Color channels with 65,536 pixel tonal levels each.

To understand how histograms come into being from all of this, imagine how it would look if we took a black-and-white image and selected 256 of its differently toned tiles (pixels) and laid them down in a line with the darkest one on the left and the lightest one on the right.

For Figure 10.19, I drew this line of tiny pixels above the familiar 10-step Zone Scale, but remember that there are actually 256 sections, or "Tonal Levels," in the histogram line.

If someone were to ask you which pixel in this line is exactly the same tonal value as a specific tone of gray in a digital photograph, you could measure that spot with a device designed for that purpose, and it would give you the exact pixel reading you were looking for. If the print value in question happened to be middle gray, its pixel value number would be 128, or halfway between 0 and 255.

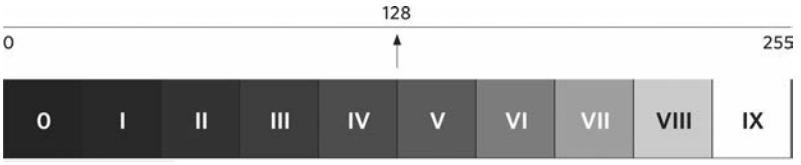

FIGURE 10.19 256 pixel tonal levels and the Zone Scale.

If you then wanted to illustrate how *many* pixels with the value of 128 there were in that image, you could either stack them up or draw a tall line if there were a lot of pixels with that tonal value or a shorter line if there were only a few.

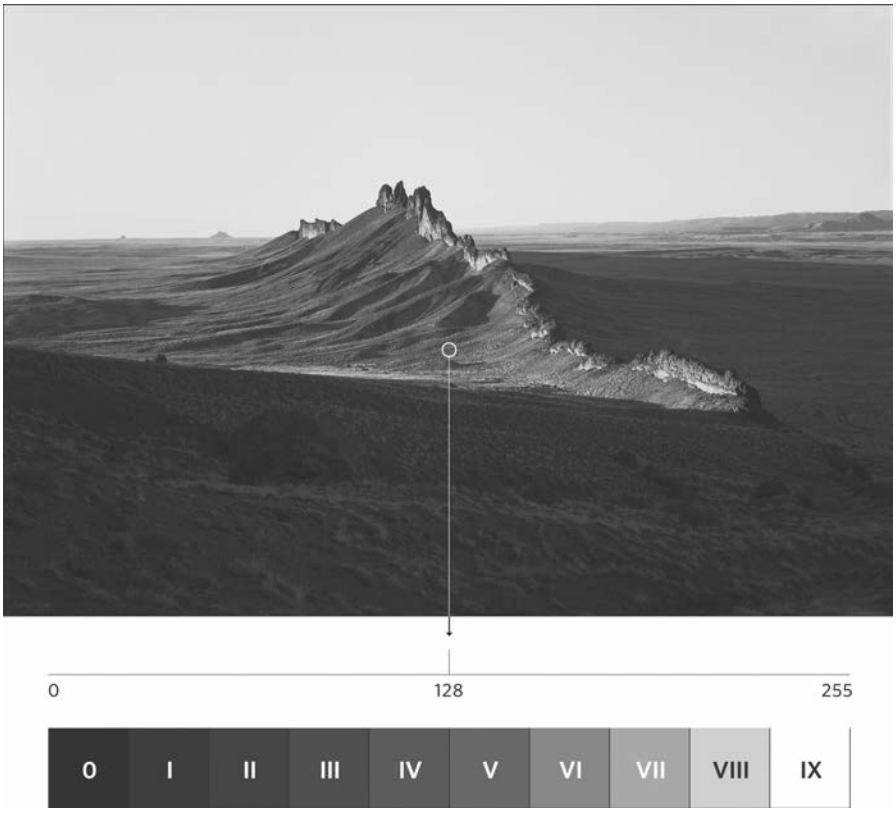

FIGURE 10.20 Pixel level 128 identified.

In this way, a complete graph of all the pixels of this image would give you a histogram that looked like Figure 10.21 when viewed inside Adobe Photoshop's Levels Command dialog box.

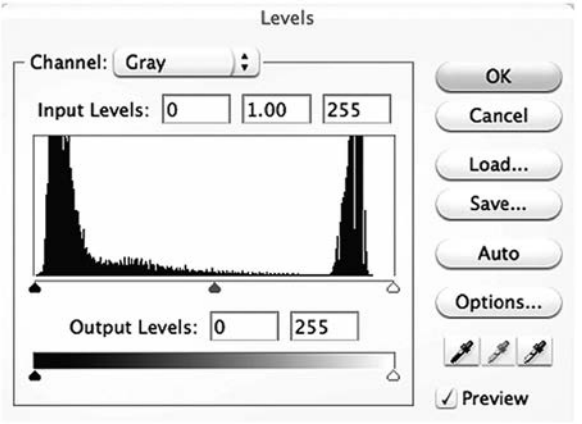

FIGURE 10.21 Digital histogram in Photoshop's Levels Command dialog box.

Notice that the Levels box has three pointers along the bottom: Black, Gray, and White. These pointers are sliders that, by default, point to pixel levels numbered as 0, 128, and 255, respectively. (The middle Input Levels box reads 1.00 because it's a measure of image contrast known as Gamma.) If a given pointer is below an empty space in the histogram, that means no pixels in the image have these values.

What this particular histogram is telling us is that the image in Figure 10.20 has:

- No pixels that are pure white
- Only a few pixels that are pure black
- Many dark pixels
- Many light pixels
- Very few pixels in the middle.

Understanding histograms is important. Study these illustrations carefully so that what they represent is clear to you.

STRETCHING THE HISTOGRAM: DEFINING THE PROBLEM OF DIGITAL EXPOSURE

So far what we have is a static representation of the pixels in this digitized image. To understand how digital editing software tools use histograms to manipulate the contrast of digital photographs and how all this relates to digital exposure, begin by imagining that you are trying to reproduce a smooth, continuous gradation by drawing very thin lines of tonal values on a strip of rubber. (If you think of each line as a pixel tonal level, this becomes a very good analogy.)

If you use enough lines of tone and apply them very carefully, it's possible to create a convincing illusion of seamlessness.

FIGURE 10.22 Digital gradation on a rubber strip.

If you then wanted to increase the representational contrast of this gradation by making the lighter end white so that the two edges of this gradation were further apart, you could think of this as "increasing its dynamic range." The simplest way to do this would be to stretch out the rubber strip as far as you wanted it to go.

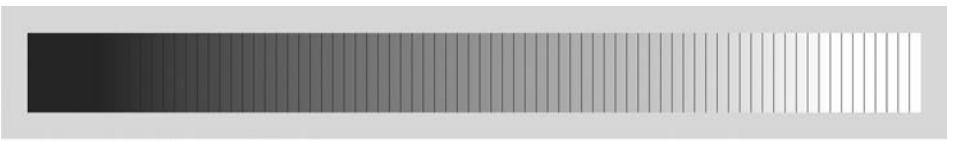

FIGURE 10.23 Rubber digital gradation with its contrast increased.

The contrast of this gradation is now greater. But notice that, because the rubber gradient has been stretched, this has the effect of separating the individual lines of the gradation and breaking up the illusion of continuity. The inherently digital nature of the representation is suddenly revealed.

Expanding and compressing the contrast of digital images is one of the basic functions of pixel-editing software, and when these gaps appear between pixel tonal levels in a digital photograph, it's called "banding" or posterization.

FIGURE 10.24 Digital banding.

Learning how to minimize this effect is an important skill for digital photographers who are trying to optimize the quality of their work.

Photographic film has no problem reproducing continuous gradations and increasing and compressing their contrast because they are seamless by nature. (Film grain isn't a factor in this discussion because even a grainy gradation still progresses from one tone to the next in a continuous but grainy way.)

When we use this illustration as a guide, the two fundamental principles that help to minimize banding makes intuitive sense:

1. First, consider that the more lines you are able to draw on the rubber strip, the more even and continuous the result will be and the more stretching it can tolerate before banding appears. In other words, *higher bit depth images are much easier to edit without compromising their quality*.
2. The less you stretch the rubber strip, the more the illusion of a continuous gradation is preserved.

I mentioned earlier that black-and-white JPEG 8-bit digital images allow for pixels to be any of 256 different tones from black to white. But Camera Raw photographs can easily be converted into 16-bit images where each pixel can be any one of 65,536 levels of tone or color! This means that you will have 256 times the number of pixel levels to work with, and this makes avoiding banding much easier. (See Appendix D for more on bit depth.)

The second principle has direct implications for how digital images should be exposed. Here's how this works. Our rubber gradation illustration makes it clear that the more you stretch out the tonal values of your subject, the more the image is degraded into noticeable digital bands. The following illustration demonstrates the relationship this principle has to exposure in digital cameras. Figure 10.25 shows an example of what happens when you underexpose an image that has average contrast with a digital camera.

[**note**] I made no contrast adjustments during the conversion from the Camera Raw state of the image and performed a simple translation of the original color image to an 8-bit grayscale file so that the tonal values will be consistent with my rubber strip gradation example.

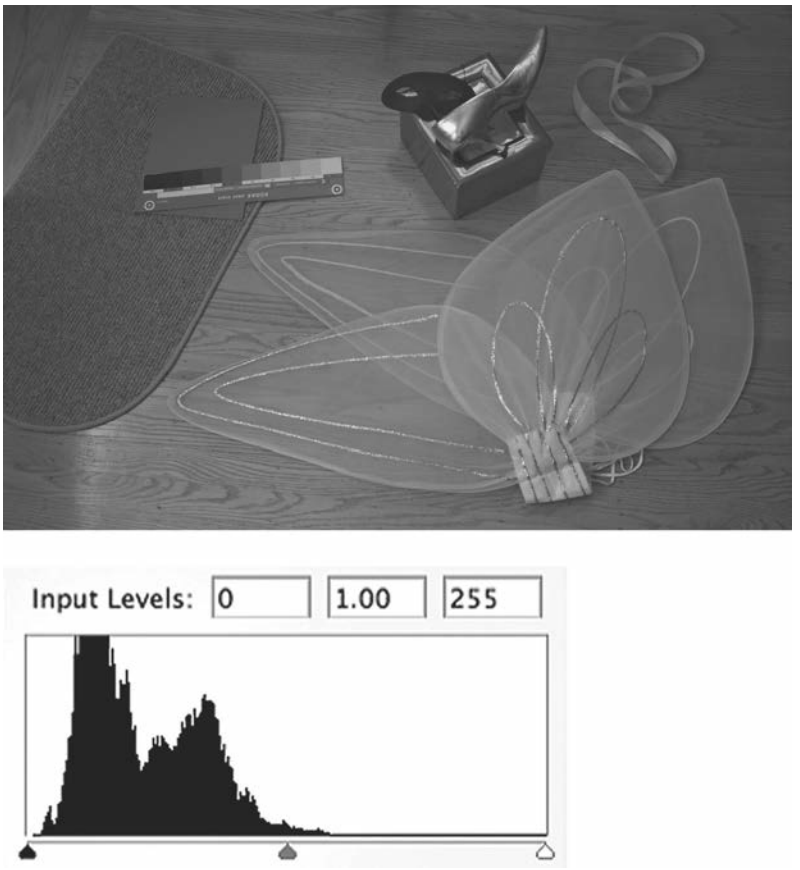

FIGURE 10.25 Histogram of underexposed digital image.

Because this image is underexposed, most of the pixels are clustered to the left of the histogram, and the pixels that represent the lightest tonal values of the image are near the middle of the scale.

In Photoshop's Levels Command dialog box, the white, black, and gray sliders allow you to change the value of an image's pixel levels in the following way. When you move a slider to a given pixel level in the histogram, you are essentially telling the software to change that level to either white (level 255), black (level 0), or middle gray (level 128). This depends on which slider you are moving.

Think of the pointers as grabbing the pixel level it is set to and literally dragging it to either the extreme right, left, or middle of the histogram. All the other levels in the histogram are either stretched out or compressed in relationship to these adjustments. The preview of the image updates itself in real time to give you a sense of how the adjusted image will look.

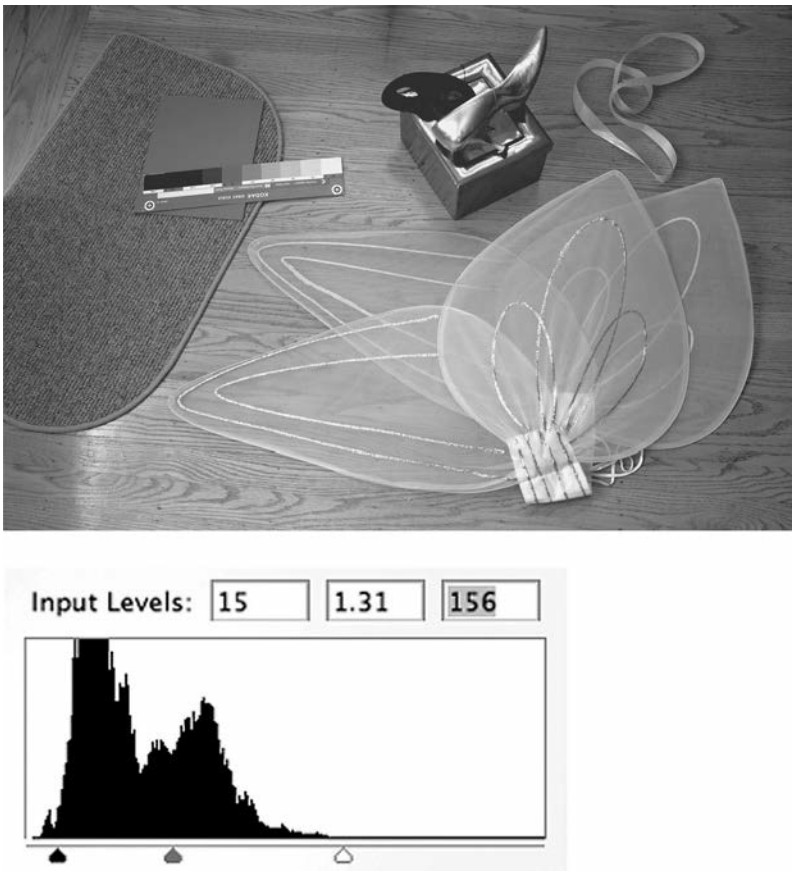

FIGURE 10.26 Histogram of underexposed digital image with levels adjustments.

Figure 10.26 illustrates a typical contrast adjustment process. The first step would be to slide the white pointer to the left until it's under the pixel value you want to be the lightest tonal value in your image.

In this case, moving the white point slider to pixel level 141 gave the image a good range of contrast in the preview. When I click OK to accept this adjustment, pixel level 141 will be dragged to the right and reset to level 255. This is called "setting the white point."

I also adjusted the black and middle gray pointers until the image's contrast looked correct. With this adjustment, the Levels Command dialog box stretches or compresses all the other pixel values of the image so that they fill the complete range of tones from black to white. Figure 10.27 shows the result.

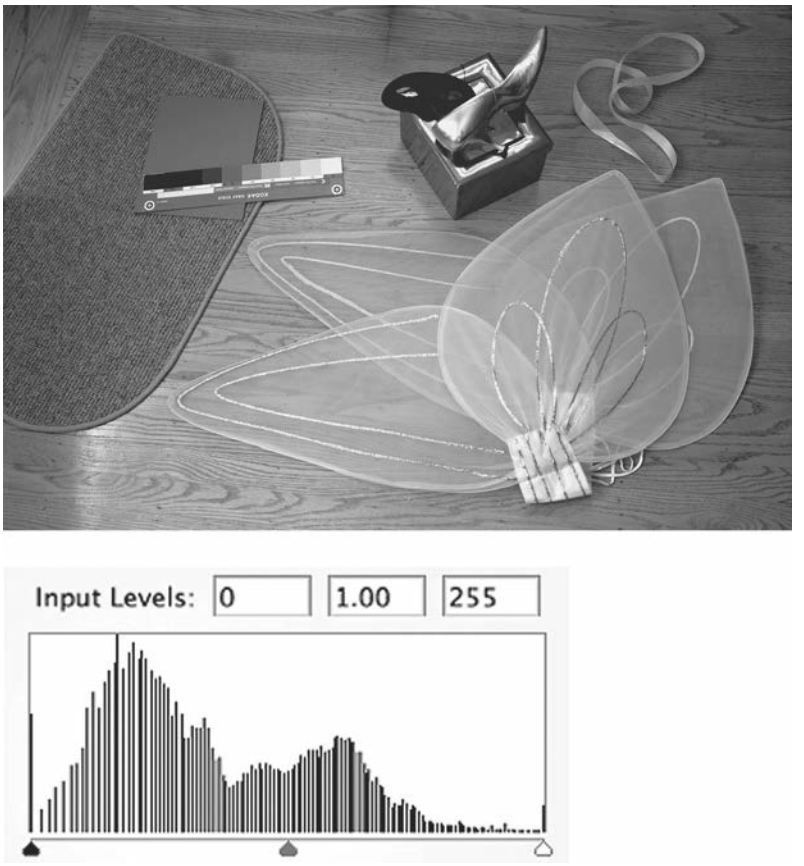

FIGURE 10.27 Histogram of underexposed digital image after levels adjustments.

There are two important things to note about this example. First, notice that when the contrast of this image is expanded, *gaps appearing in the histogram indicate tonal values that aren't present in the image*. Before I made this adjustment, all the pixel levels were clustered together, and the image values were more continuous. Now that the contrast has been expanded, there are gaps and the digital nature of the image is more obvious.

Figure 10.28 shows a detail of the effect this has on the shadow areas of this illustration. This image was shot at ISO 200, so what looks like noise in this shadow area is actually the loss of tonal levels or banding. Some degree of banding is inevitable when you edit 8-bit digital image files, but minimizing this effect is the key to achieving the best quality in your work.

The second thing to notice in Figure 10.28 is that the banding effect is greatest in the darkest tonal values of your image. There are far more gaps on the left side of the gray pointer in the middle than on the right side. The shadow values suffer the most from this process because fewer pixel levels were devoted to them in the first place. The reason for this problem is explained later in the section "The Problem of Digital Shadows" and in Appendix A.

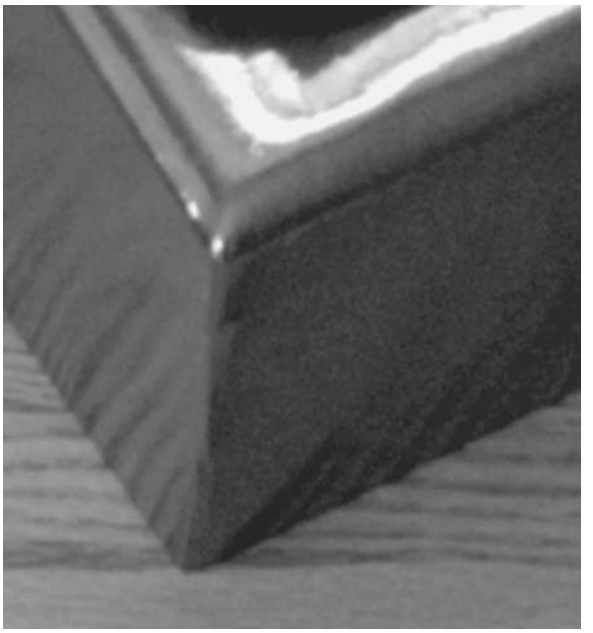

FIGURE 10.28 Detail of banding in an underexposed digital image.

The Zone System of Digital Exposure

EXPOSING FOR THE HIGHLIGHTS AND EXPOSING TO THE RIGHT

The best way to minimize the effects of banding in digital images is to learn how to make accurate digital exposures that place your highlights as close as possible to where they should be on the right edge of the histogram. This is called "exposing for the highlights," and there are two reasons why this works. The first is fairly obvious and is demonstrated in the illustrations shown in this section. The second is more subtle but just as important and is discussed in the next section, "The Problem of Digital Shadows."

Exposing for the highlights is a valuable technique. Using the language of the Zone System, placing the Important Highlights on Zones VII or Zone VIII where they belong minimizes the need to stretch out the image's pixel levels, which causes banding and posterization in the shadow areas.

Figure 10.29 shows the same image as the previous example but with an exposure designed to place the meter reading of the Important, textured, white highlight values on Zone VIII. Any brighter areas of the subject are specular reflections that can be rendered as Zone IX. Notice that when compared to Figure 10.27, the tonal values of this histogram are shifted substantially to the right. This is why this technique is often referred to as "exposing to the right."

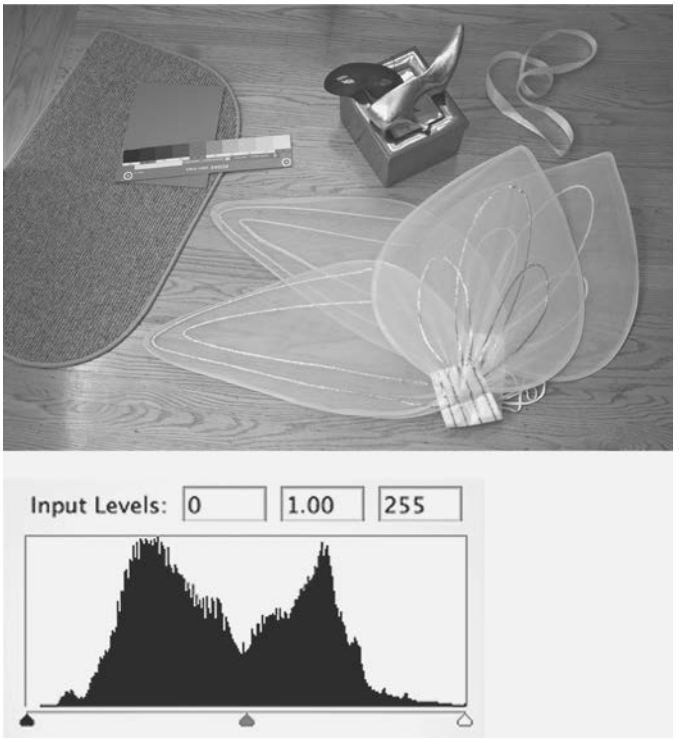

FIGURE 10.29 Histogram of properly exposed digital image.

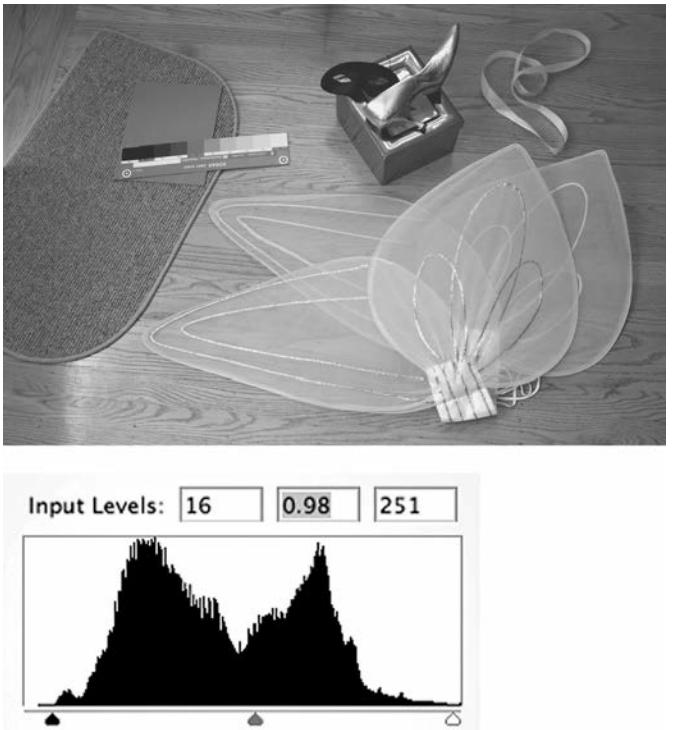

FIGURE 10.30 Histogram of properly exposed digital image with levels adjustments.

Figure 10.30 shows the adjustments made to match the contrast of the Figure 10.27 as closely as possible.

Notice that only slight adjustments of the white, black, and middle gray sliders were necessary because the exposure was correctly placed on the Zone Scale.

Figure 10.31 is the image and histogram that resulted from these adjustments.

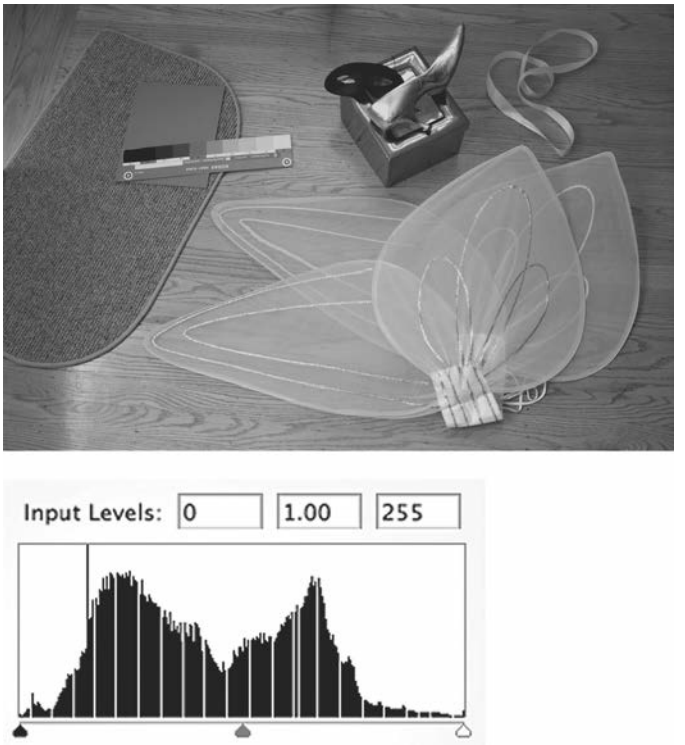

FIGURE 10.31 Histogram of properly exposed digital image after levels adjustments.

Note that, compared with the histogram from Figure 10.27, which is shown again here, there are far fewer pixel-level gaps using this method, and the gaps are much more evenly distributed across the histogram.

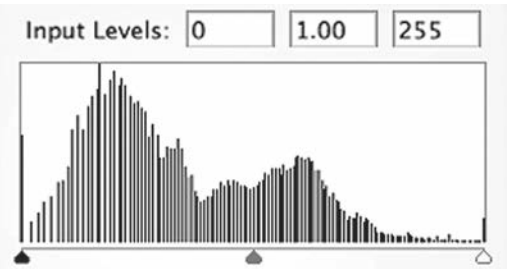

FIGURE 10.27 Histogram of underexposed digital image after levels adjustments.

A careful comparison of details from these two examples shows that proper exposure greatly improved the quality of the shadow areas.

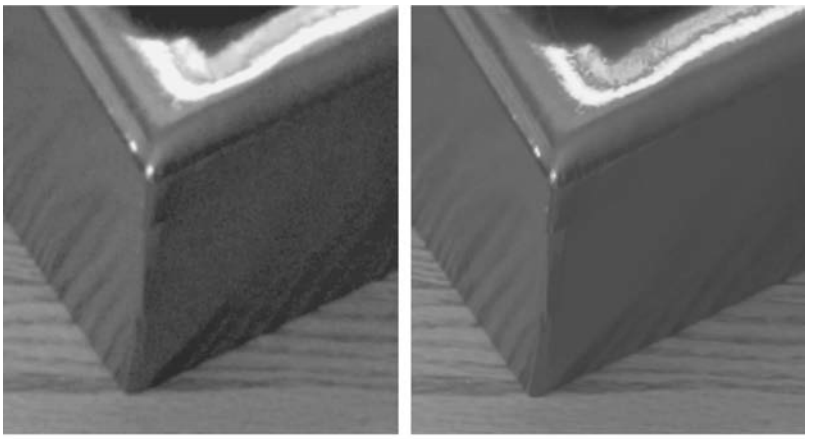

FIGURE 10.32 Details of shadow of underexposed and properly exposed digital images. (A) Underexposed; (B) properly exposed.

THE PROBLEM OF DIGITAL SHADOWS

The reason this process is especially damaging to the shadow areas is because of the second, more subtle reason I mentioned earlier. The fact is that current digital cameras inherently devote more levels of brightness values to rendering detail in the highlights than they do to the darker areas of the subject.

When I introduced the illustration showing how pixel levels could be stretched out if they were drawn on a strip of rubber, for the sake of clarity, I intentionally skipped a step in the process and illustrated it as shown in Figure 10.33.

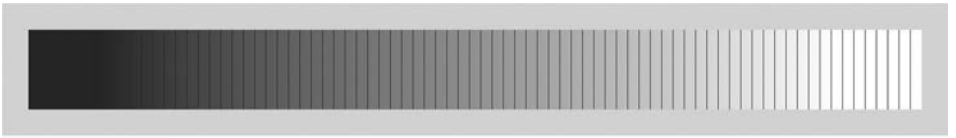

FIGURE 10.33 Gradation and pixel levels of a nonlinear, converted digital spectrum.

This figure actually shows the way an expanded gradation would look *after* it had been converted from its raw digital state into a Photoshop or .tiff file.

Notice that in converted files, the pixel levels that make up this spectrum are distributed evenly from one end to the other, and the spectrum itself is even and balanced with middle gray in the center. Also notice that the shadow areas are defined by the same number of levels as the middle values and the highlights. This approximates to the way our eyes perceive light, but it isn't at all the way digital cameras convert analog to digital shadow and highlight values in unconverted raw files.

A more accurate representation of the way these tonal values and levels are distributed across the spectrum in *raw* digital images would look like Figure 10.34.

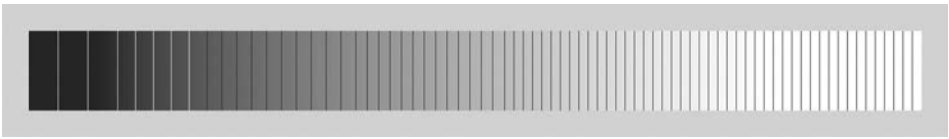

FIGURE 10.34 Gradation and pixel levels of a linear, unconverted digital spectrum.

Two important things are obvious in this illustration. First, in Camera Raw image files, much more of the spectrum is devoted to the highlights than is true in Figure 10.33, where middle gray is shifted over to the left. Second, the shadow values in raw digital images are defined by far fewer tonal levels than are the middle and highlight values.

The process of converting Camera Raw files into the normal formats we work with in Photoshop is called "tone mapping," and as you can see, it makes a profound difference in the characteristics of the file. The reason unconverted raw files are structured this way is explained in Appendix E on exposure and the digital linear effect.

Looking again at Figure 10.27, we can understand that the second reason why stretching the histogram creates more gaps in the shadow areas is that it had fewer pixel levels there to begin with!

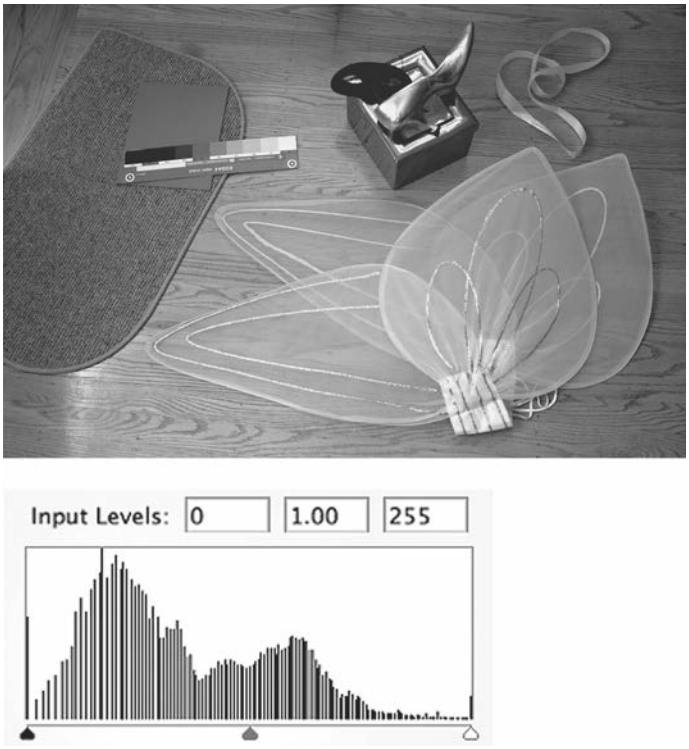

FIGURE 10.27 Histogram of underexposed digital image after levels adjustments.

The way to minimize this problem is to expose your digital files so that your subject's shadow areas fall as close to the middle of the histogram as possible. The further they are away from the darker end of the histogram, the better. The Zone System provides you with a simple way to achieve this result.

DIGITAL EXPOSING FOR THE HIGHLIGHTS

It should now be clear that there are important technical advantages to properly exposing digital image files, but using the Zone System with 35mm cameras always requires some extra effort.

With roll-film cameras, the problem always is how to apply individual contrast control to frames that must be developed together. That isn't a problem with digital 35mm frames, but there is still the issue of metering selected areas with built-in light meters.

Because it's so easy to preview digital photographs using the camera's LCD window, one practical solution would be to take a quick reference meter reading of your subject and note where the histogram falls on the scale from right to left.

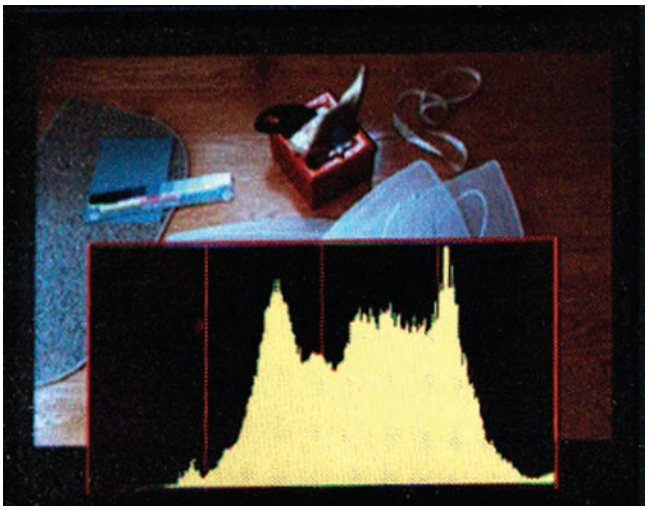

FIGURE 10.35 Camera histogram of underexposed digital image.

If the image is too dark, you could simply open up one or two stops using either apertures or shutter speeds until the histogram is as far right as it needs to be to avoid the problems caused by expanding the contrast.

Moving the histogram levels too far to the right would be overexposure and cause the subject's highlight values to fall off the edge of the histogram, where they would be lost. (The consequences of this will be discussed in the section "The Zone System and Digital Contrast Control.") This is a quick and very simple exposure method (and this is what many digital photographers actually do), but there is one issue that, if you're shooting raw image files, makes this approach less precise than it appears to be.

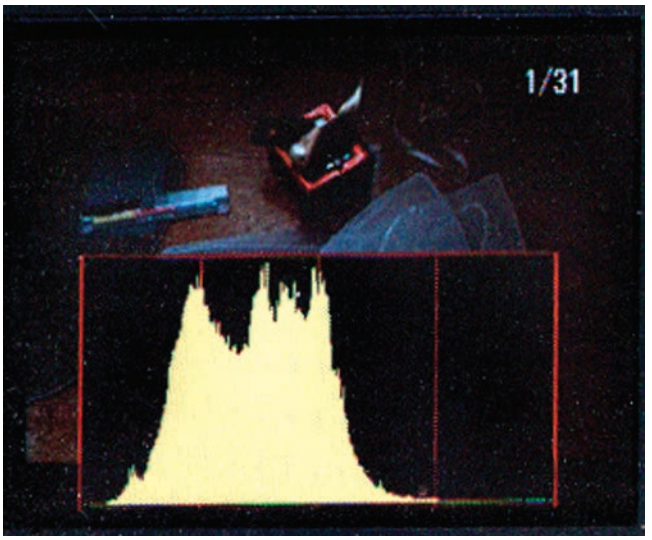

FIGURE 10.36 Camera histogram of digital image exposed to the right.

As I mentioned at the beginning of this chapter, digital camera previews are generated based on assumptions about how you will eventually want to use the image. One of those assumptions is that you're shooting for JPEG images that are compressed. If you are shooting in raw format, which you should be, this means that the histogram the camera creates won't precisely match the one you will eventually be working with. This issue also applies to the flashing "out of gamut" highlight warnings that are a function of many digital SLR cameras. When your preview is set to this function, it can give you the alarming impression that your highlights are blown out when, if you are shooting in raw format, they may in fact be recoverable.

As mentioned at the beginning of this chapter, higher-end DSLRs offer Live View functions that are very useful for previsualization. But, a more precise exposure approach would be one that accurately placed your subject's highlight values where they should be on the Zone Scale. Photographers who are experienced with properly exposing transparency films are very familiar with this variation of the Zone System, which is much more accurate and consistent.

If your in-camera light meter has a spot metering function or if you have a handheld spot meter, follow these steps:

1. Carefully meter the Zone VII Important Highlights of your subject.
2. Make note of the meter's recommended exposure for these areas.
3. Because Zone V is two stops darker than Zone VII, opening up two stops from the meter's recommended exposure for the textured highlight will accurately place them on Zone VII.

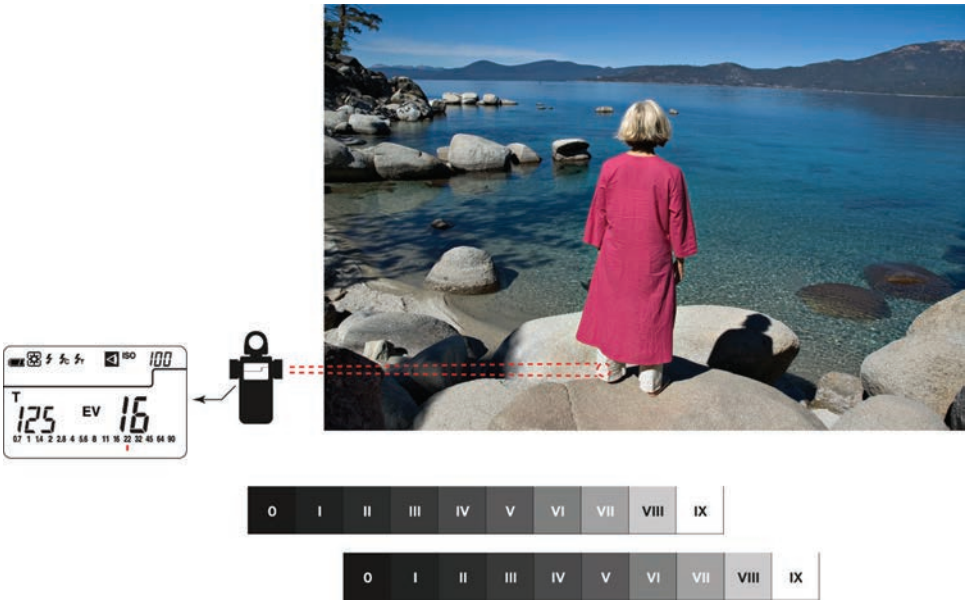

FIGURE 10.37 Meter's recommended exposure: Zone VII on Zone V. Remember that the meter's recommended exposure would render these areas as Zone V or middle gray.

FIGURE 10.38 Important Highlight placed on Zone VII.

This will be the perfect exposure for digital cameras! Chapters 4, "The Zone," and 5, "Exposure," explain the general theory behind this process in great detail.

With compressed 8-bit JPEG photographs, you have relatively few pixel levels to work with, so the editing required to correct bad exposures can seriously degrade your image. Although this Zone System-oriented approach to digital exposure will work extremely well with JPEG images, it's important not to overstate the importance of using this method when you're shooting Camera Raw files for your general purposes.

As you will see, the conversion process from raw files to tone-mapped digital images offers you many powerful tools for manipulating the exposure and contrast of your photographs. Adobe's Camera Raw converter allows for effective exposure control that can, to some extent, compensate for exposure and contrast problems. What the Zone System adds to this process is the ability to make consistently precise exposures that require less correction in the conversion stage; it allows you to think creatively about how to use exposure in imaginative ways.

A Summary of Digital Exposure Effects

Let's summarize what we have learned about digital exposure:

1. It's important to shoot using the lowest ISO that is practical in a given lighting situation. This will minimize the noise in your images. The higher the ISO, the more noise there will be in the shadow areas of your images.
2. You should always shoot in Camera Raw format unless you're sure you will never need the extra bit depth that this setting provides. This will give you many more tonal levels to work with when you're editing your photographs.
3. Underexposure of digital images results in a histogram that has its brightness levels clustered to the left where there are inherently fewer levels defining the shadows of your subject.
4. This requires you to stretch out the histogram to enhance the image's contrast, which causes banding that has its greatest effect on the shadow values of your subject.
5. The solution is to **expose for the highlights**, which reduces the need to expand the image's contrast and minimizes banding in the shadow areas.
6. Properly applied, this method will leave you with digital files that are ideally suited for the contrast control methods, which are described in the next section.

The Zone System and Digital Contrast Control

In Chapter 2, "Print Quality, Negative Contrast, and Dynamic Range," I used the myth of the ancient diabolical innkeeper Procrustes as an analogy for how the Zone System allows you to modify the contrast of your negatives so that they print well on the grade of photographic paper that you prefer for your work.

The myth tells the story of how Procrustes would either stretch his unwitting shorter clients on a rack until they were long enough for his bed or chop off their legs if they were too tall. This is similar to the way that the Zone System allows you to systematically either expand or compress the contrast of your negatives so that they match the "Procrustean Bed" of your chosen photographic paper grade.

Here's a quick review of how this process works. The first step is to carefully meter the subject area that you want to be Zone III, dark with full texture and detail.

We have learned that light meters always recommend exposures for what they see that will print as Zone V or middle gray. Therefore, if we were to use the meter's recommended exposure for this area, the negative would be overexposed by two stops.

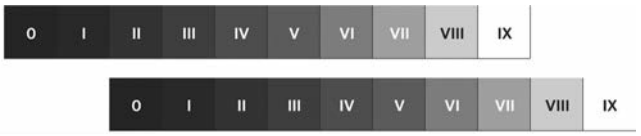

FIGURE 10.39 Zone V placement of an area previsualized as Zone III.

Stopping down two stops will place the meter reading for the area previsualized as Zone III on Zone III where it belongs. If, as in this example, the Important Highlight falls on the appropriate Zone, then the negative would receive Normal Development.

FIGURE 10.40 Zone III placement of an area previsualized as Zone III.

If the Important Highlight reading falls too low on the Zone Scale, we would need to increase the development time to stretch the contrast of the negative until it matches the paper's tonal scale. This is called N + Development; in this case, N + 2.

FIGURE 10.41 The effect of Normal Plus Two Development.

If the subject's Important Highlights fall too high on the scale, we reduce the negative development time enough to compress the highlights until they fit properly on the scale. This is known as N– Development; in this case, N – 2.

FIGURE 10.42 The effect of Normal – 2 Development.

The reason this process works is that film is an inherently analog, continuous-tone medium that, within limits, allows for the compression or expansion of negative contrast without the problems we discussed that are associated with digital processes.

Many photographers have had the experience of seeing a negative that has detail in highlight areas that's visible when viewed against a strong enough light source but simply won't print on contemporary photographic papers. This demonstrates that the detail was present in the latent state of that image and could have been rendered printable if the development time had been correct. Digital imaging processes behave in a very different way.

THE LIMITS OF DIGITAL PHOTOGRAPHY

Digital and film photography share one common goal: To capture as much subject information as possible so that it's available to work with when you make your finished print.

In film, severe underexposure results in shadow detail that's lost in clear, empty areas of film. Extreme overdevelopment creates highlight film densities that are opaque and print as empty pure white areas. Similar problems exist in the world of digital photography, but the causes and terms we use to describe them are different.

Underexposed digital images aren't only dark and lack shadow detail; they also have dark tonal values that are contaminated with "noise" or random patterns of bright and colored pixels that degrade the quality of the image. This is especially true when you shoot digital photographs using higher ISO ratings like 1600 to 3200. This means that with digital materials you have to be concerned both with your shadow areas being too dark and lacking detail and with noise as an aesthetic factor.

[**note**] As of this writing there have been major advances in the digital image sensors of mid- to high-end professional cameras so that it is now possible to shoot at ISOs equivalent to 51200 or higher.

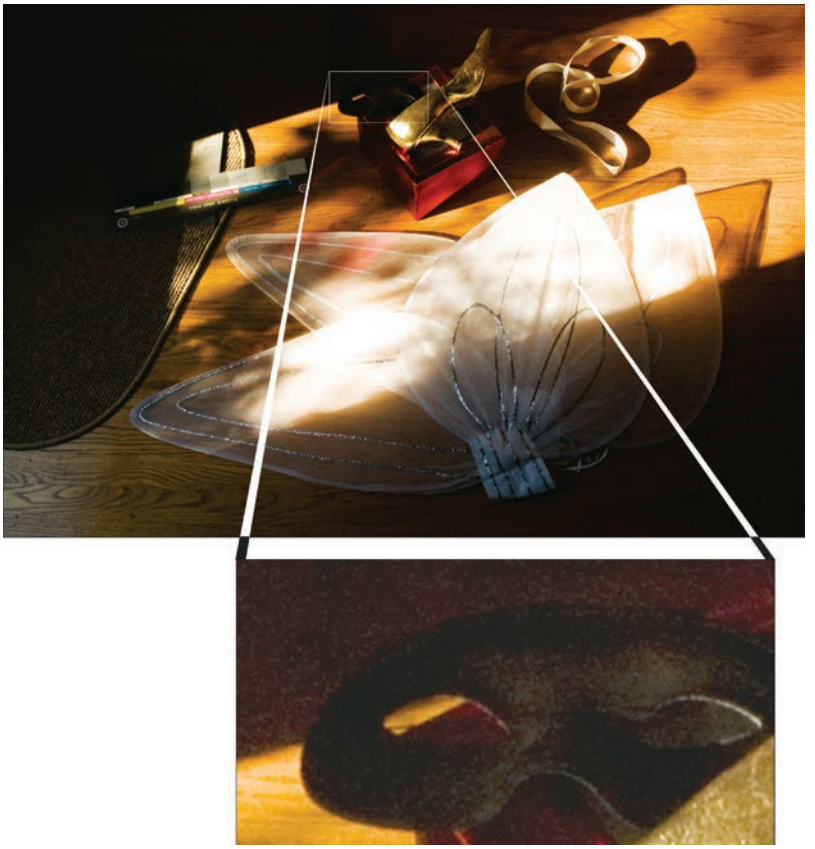

FIGURE 10.43 Digital noise in a high-contrast image.

For this illustration, I made the shadow area lighter to make the noise more visible.

At the other end of the scale, traditionally film has generally been more forgiving when it comes to recording high-contrast subjects. The ability of an imaging medium to record subject contrast is called its dynamic range. Dynamic range is usually measured in the number of f/stops you can increase your exposure before the medium stops recording a visible difference between one stop and the next.

Black-and-white and color negative films have a dynamic range of about 11 to 14 stops. Currently, 35mm digital single-lens reflex imaging sensors have a dynamic range that is closer to an average of 10 stops.

[**note**] This is another area where improvements to digital sensors have been dramatic. High-end professional digital cameras and scanning backs have a dynamic range of 14–15 stops, but they are very expensive.

We have learned that, within limits, the highlight values of a high-contrast subject can be pulled to within the dynamic range of film by reducing the development time. "Overdevelopment" means neglecting to do this. The term "overdevelopment" doesn't apply to digital camera chips, but the problems caused by attempting to photograph scenes with too much contrast are just as severe as with film.

Digital images are made of pixels or individual picture elements. Texture and detail in a digital photograph is represented by a tonal difference between one pixel and its neighbors. If the dynamic range of your subject is too great, the light from the highlight areas will be too bright on your digital chip, which causes the tonal value of one pixel to "bloom," or bleed over to adjacent pixels. This has the effect of obliterating detail in that area of the scene. The result is a bleached-out white area with no useable detail.

FIGURE 10.44 Blown-out highlights in a high-contrast digital image.

Histograms give us a very clear way to see this effect in terms that are especially appropriate for our Procrustean analogy.

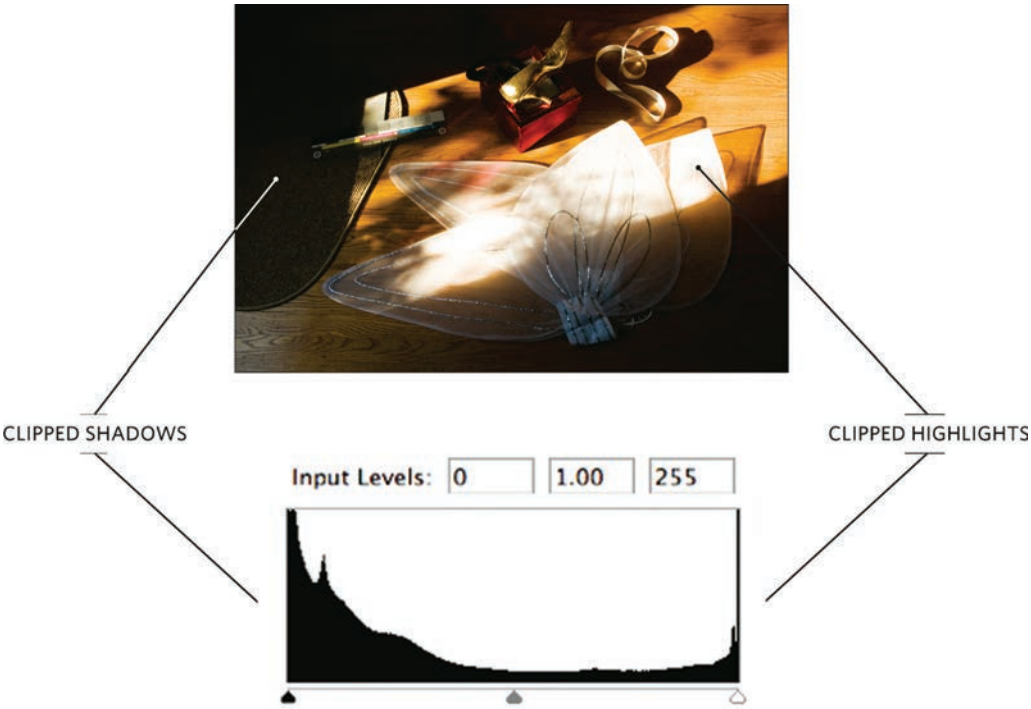

FIGURE 10.45 Clipping in a high-contrast digital image.

As you can see in this illustration, both the shadow and the highlight pixel values of this image end abruptly at the extreme ends of the scale.

Subject values that fall below 0 or above 255 are said to be "clipped," meaning that they are beyond the range of tonal levels that can be printed. Once a shadow or highlight area is clipped in a digital image, the texture and detail are simply gone and can't be recovered—although there are special techniques that, within limits, can help with this problem. These are described in the section "Dealing with High-Contrast Subjects."

THE ADOBE CAMERA RAW ADVANTAGE

The process of converting a digital image from its latent state, as it exists after exposure on your camera's storage media, to the edited version in Photoshop is extremely complex, and a detailed discussion of this process is beyond the range of this book. (See Appendix W for a reference to a book that will fully explain the details of working with images in Adobe Camera Raw.)

But it's important to have at least a general idea of what happens at this stage so you can make informed decisions about how to proceed. The first thing to understand is that all digital images start out as grayscale data after the light from the lens passes through an array of tiny colored Bayer filters positioned in front of the camera's CMOS or CCD photosensitive detectors. (Foveon sensors work differently in this regard and are superior in many ways.) This means that the grayscale image data has to be converted into color information before it can be displayed.

Next, digital sensors measure light in very different ways than either film or our eyes do. Human vision responds to light in a distinctly nonlinear way, whereas analog-to-digital converters simply measure amounts of photons in a strictly linear manner. The bottom line is that digital images need to go through a process called tone mapping before they will look natural to our eyes. (See Appendix E for a more complete description of this issue.)

The important implication of all this is that any image corrections you make at this stage of the process are fundamental and generally much less damaging to the quality of your image than editing done in Photoshop. There are also ways that you can color-correct and otherwise interpret images during the conversion process that simply can't be duplicated in Photoshop.

This is the reason for the next cardinal rule for digital photographers: **Do as much image correction as possible (without losing vital shadow or highlight values) during the raw conversion stage before editing your image in Photoshop.**

[**note**] Scanners can't produce raw-formatted files that can be opened and edited using the Adobe Camera Raw utility. The reason is that scanners are creating digital images from sources that have already been through the conversion process, either as the negative or slide you are scanning or the print made from that film. This means that the .nef files produced by Nikon film scanners aren't the same as the raw files captured by Nikon digital cameras.

Hasselblad/Imacon are able to scan film to a proprietary 3F format (.fff) that they define as being "raw" in the sense that it can be edited with special software before being converted to a tiff or JPEG file. These should not be mistaken for the nontone mapped Camera Raw files that we have been discussing.

Appreciating the importance of the raw conversion process leads directly to the question of what software you should use to do this. There are two general choices. Every manufacturer of digital cameras offers proprietary software specifically designed to convert its raw files. Nikon Capture NX and the Canon RAW Image converter are examples of this kind of software.

But here we come up against what I have discovered to be a very reliable fact: Camera manufacturers aren't as proficient or creative at designing digital editing software as is a company that makes this its primary business. Added to this is the fact that all digital images eventually end up being edited in Adobe Photoshop in any case, so you are better off using software that is specifically designed to be compatible with this environment.

CUSTOM CAMERA PROFILES

With professional-level digital cameras, it's possible to use the manufacturer's software to apply special profiles to your images that internally modify the contrast of each photograph as you shoot. These profiles have the effect of either increasing or decreasing the image's contrast in subtle and nondestructive ways. You can even use special software to create custom profiles that you can upload into your camera for use in unusually flat or contrasty situations.

The problem with using these custom camera profiles is that you have to remember to apply them every time you are shooting a subject with unusual contrast. Also, these profiles are generalized and apply the same degree of contrast adjustment to every image, regardless of its unique characteristics.

One reason for my strong recommendation to use a dedicated Camera Raw utility is that it provides some of the most practical software solutions available for the problems associated with high-contrast digital photography.

Raw Converter Choices

A number of excellent raw conversion applications are available, and they tend to fall under general headings, as described next.

STANDALONE RAW CONVERTERS

Standalone raw converters are not integrated into either digital back or camera systems or digital editing systems such as Adobe Photoshop. DxO OpticsPro 11 RAW converter support all the major digital SLR camera formats, and has excellent converting software and feature set.

INTEGRATED RAW CONVERTERS

Integrated raw converters are all extremely high-quality, sophisticated applications that differ depending on what kind of system they are integrated into. Some, such as Capture One, are integrated into the Phase One system of high-end digital camera and back systems, but they also bring a host of important features when used with all major DSLR cameras. If you can afford the price of Phase One or Leaf cameras and backs, together with Capture One software, you will be operating at the very highest levels of digital capture and output capabilities.

Adobe's versatile Lightroom application is, of course, integrated into the Adobe Photoshop Creative Cloud of digital editing applications, and like Capture One, Lightroom CC also functions as a data asset manager, allowing you to catalog your image files in numerous practical ways.

All these converters have features that recommend them, but for the purposes of this text, I will simplify this issue by referring only to the functions of Adobe's Camera Raw utility. In a sense, this utility is the ultimate of Camera Raw integration because it only exists as a plug-in within the Adobe Creative Cloud set of applications. This means that Adobe can upgrade the raw converter without having to create all the surrounding interface software. This tight integration with Photoshop means that it allows for the establishment of a coherent workflow that's very efficient. Another reason is that it simply does an excellent job and the features covered here are more or less transferable to all the other applications.

An Introduction to Adobe Camera Raw Utility

When you open a raw digital image with the Adobe Camera Raw software, it totally disregards your camera's internal profiles and instead applies its own unique and highly sophisticated software solutions. Because Adobe's Camera Raw utility is working with the completely linear, unconverted data from your camera's chip, it has tools that can perform subtle image adjustments that are impossible to duplicate in Photoshop itself. (See Appendix A for more details on this subject.)

Two of the most useful of these tools are

- The Temperature Adjustment, which actually allows you to change the tungsten or daylight color balance of your image, regardless of the light source illuminating the subject.
- The Exposure Adjustment, which, within limits, can reproduce the effects of increased or reduced exposure.

All of Adobe Camera Raw's adjustments are far more precise and subtle than what you can do with internal camera profiles. The following two subjects utilize some of these tools to correct digital image contrast problems that you will inevitably have to deal with.

DEALING WITH LOW-CONTRAST SUBJECTS

One of photography's more reliable truisms is that, in general, correcting the contrast of subjects with relatively low contrast is much easier than dealing with high-contrast situations. The reason is that, if properly exposed, all the visual information in a flat scene will easily fit within the printable dynamic range of both digital chips and films and papers.

Your goal then is to increase the contrast of your image without pushing it too far. With film, you do this by using the Zone System to calculate the proper development time. With digital images, there are just a few steps to the process of correcting low-contrast images.

[Step 1]

The lack of contrast in low-contrast subjects means that the relatively few levels of tones in the images must be stretched out to render them with a full range of tonal values in the final print.

For this reason, whenever possible, you should scan at high bit depths or shoot your images in raw format so that there are enough pixel levels to work with in this process. Be aware that 8-bit JPEG images only allow each pixel to be no more than 256 different tones or colors per channel. Most cameras provide the option of shooting in 12- or 14-bit raw formats that allow for either 4,096 or 16,384 tonal levels per channel, respectively. This gives you many more pixels to work with as you stretch them out to increase the contrast as necessary

[Step 2]

Next, it's important to make sure that your exposure places the highlight reading as close to the proper Zone VII value as possible so that the available levels don't have to be stretched too far. (See the earlier section "The Zone System of Digital Exposure" for a complete description of why this is important.)

The following is a brief summary of the steps detailed in the earlier section "Exposing for the Highlights and Exposing to the Right."

- Carefully meter the Important Highlights of your subject.
- Make note of the meter's recommended exposure for these areas.
- Remember that the meter's recommended exposure would render these areas as Zone V or middle gray.

- Because Zone V is two stops darker than Zone VII, opening up two stops from the meter's recommended exposure for the textured highlight will accurately place them on Zone VII. This will be the perfect exposure for digital cameras!

Chapters 4 and 5 of this book explain the general theory behind this process in great detail.

[Step 3]

If you are shooting in raw format, you can do quite a lot to correct image contrast problems as part of the conversion process to standard image formats.

The following example shows how I used the Adobe Camera Raw utility to add contrast to an image shot in the low light interior of a museum in Barcelona.

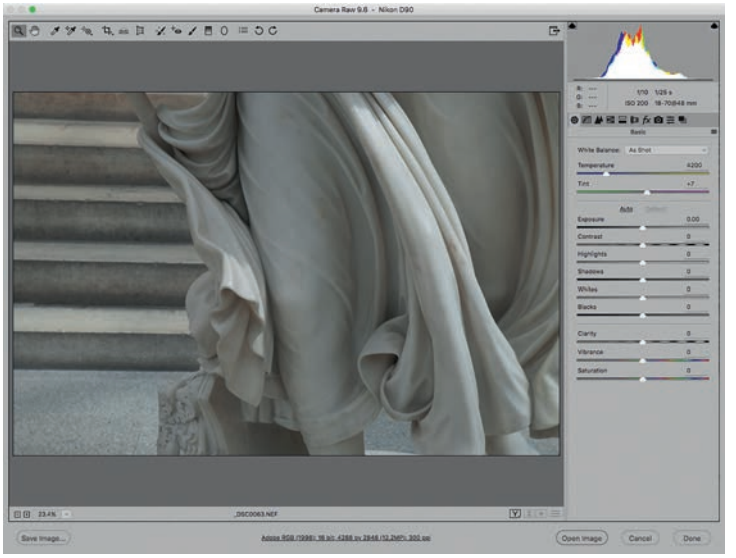

FIGURE 10.46 Adobe Camera Raw utility—low-contrast digital image.

The built-in histogram shows that the image's tonal values are clustered toward the middle values, which is a graphic way of illustrating the low contrast of this image.

After two quick adjustments of the Exposure, Contrast, Shadows, Blacks and Whites sliders, the image has a much improved range of tonal values.

It's important to take full advantage of these controls before you make adjustments to the image's contrast in Photoshop. (Again, remember to preserve the image's shadow and highlight values.)

If you shoot your digital images in JPEG format, you don't have the full advantage of using these conversion adjustments.

The earlier section "The Zone System of Digital Exposure" provides illustrations and a simple step-by-step description of how to use Photoshop's Levels Command dialog box to correct the problems associated with photographing low-contrast subjects.

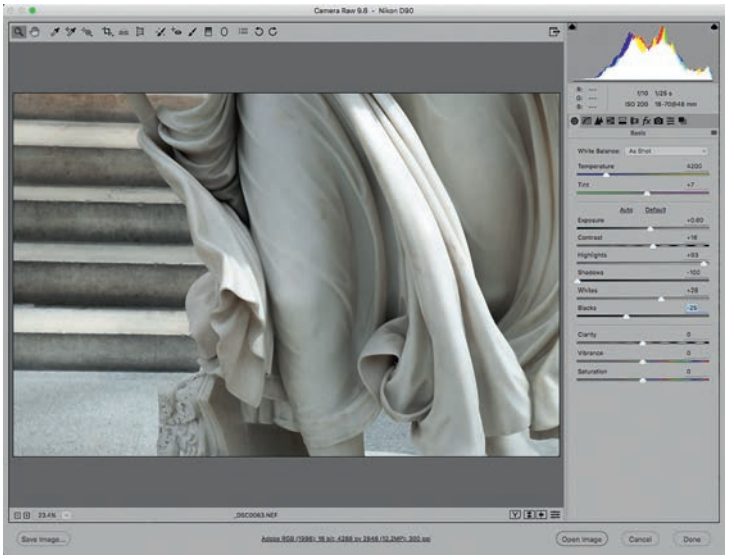

FIGURE 10.47 Adobe Camera Raw utility—low-contrast image adjustments.

Needless to say, in Photoshop, there are many other methods for adjusting image contrast beyond what you can do with the Levels Command dialog box. (See Appendix W for a list of references to books that fully explain these techniques and methods.)

DEALING WITH HIGH-CONTRAST SUBJECTS

An Advantage of Film

Because of the relatively limited dynamic range of current DSLR photo sensors, there are more special techniques and proposed software solutions to the problem of dealing with high-contrast subjects than almost any other issue in digital photography.

In a technologically driven culture, there's a tendency to believe that digital processes must have advanced solutions to all photographic problems. In very many areas, this is true, but as of this writing, there is one problem for which film, especially black-and-white negative materials, retains a distinct advantage.

Because of the current limitations on what the dynamic range digital chips can record, there is nothing simple or straightforward you can do if the contrast of your subject is greater than 10–15 stops and **your subject or the camera is moving**—for example, if you're photographing wind-blown trees or water flowing or people walking.

There are a number of remarkable techniques that allow digital photographers to record and print an extraordinary dynamic range of tonal values far beyond what is possible with any film, but the problem is, unless your goal is to make aesthetic use of special effects, these techniques work well only with subjects that can be shot when the camera is on a tripod and the subject is not in motion. This amounts to a fundamental difference between digital and film photography that may help you decide to stick with one or the other. If very high-contrast photography of

candid, moving subjects is at the heart of your work, you may be frustrated with this limitation with digital processes.

Once again, though, it's important not to overstate this issue. Fill flash techniques can compensate for this limitation, and there are so many other advantages to digital photography that it's doubtful that this issue will dissuade many potential photographers.

High-Contrast Digital Subjects: Two Approaches

The following are two different approaches to the problem of dealing with high-contrast subjects. One is for situations in which the contrast range is just beyond what digital sensors can record. The other is a radical technique designed to produce dramatic results from situations in which the contrast is far beyond what could be captured with normal methods.

[**note**] Adobe Photoshop provides for a number of other effective ways to reduce the contrast of high contrast images. A good example is the use of Luminosity Masking, a technique that is beyond the scope of this book. You can find detailed tutorials for how to do this by subscribing to Lynda.com.

Highlight Recovery

Camera Raw's Highlight Recovery slider is a very useful feature that is specifically designed to pull any detail that there may be in what otherwise appears to be totally clipped highlights.

For this feature to work, your highlight values can't be more than one quarter to one stop beyond the range of the histogram, and there has to be room to darken your shadow values without losing valuable image information. In other words, this is a remedy for photographs where the highlights are not too far beyond the dynamic range of your sensor.

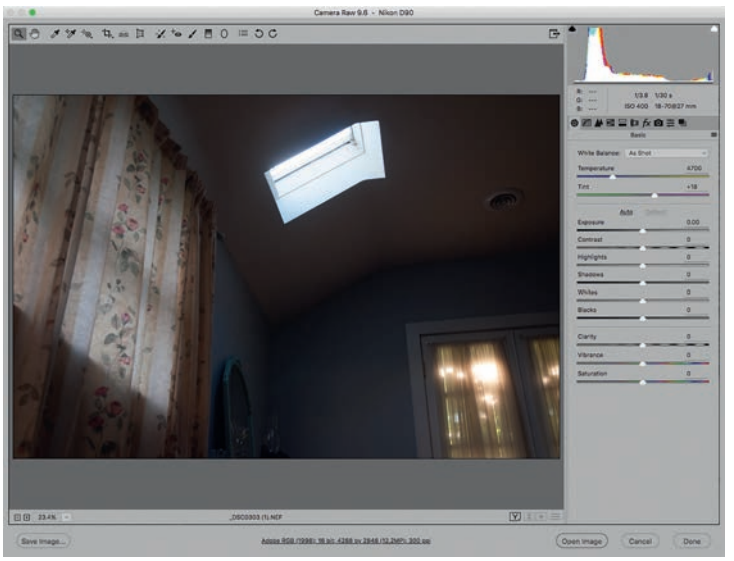

FIGURE 10.48 Adobe's Camera Raw utility—high-contrast digital image.

The following detail shows that the highlights in the skylight are blown out, and the red out of gamut warning shows that these channels are clipped.

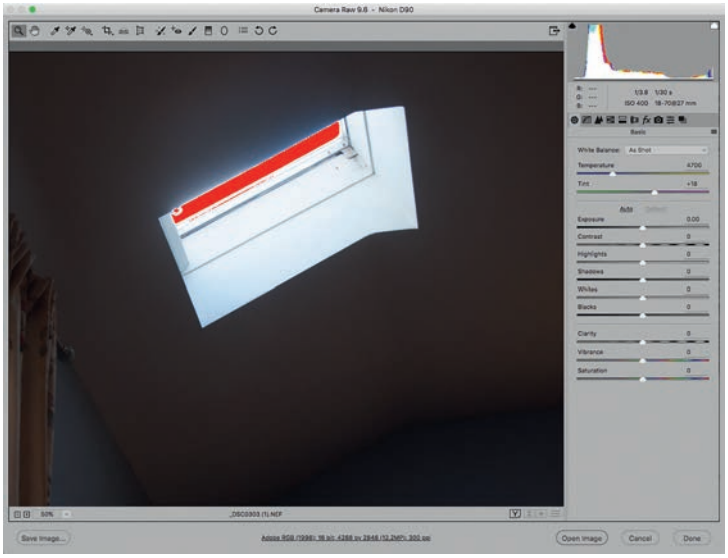

FIGURE 10.49 Detail—high-contrast digital image—before highlight recovery exposure adjustment.

When the Exposure Adjustment is moved to the left, the image gets darker, and the detail is recovered in the highlight areas.

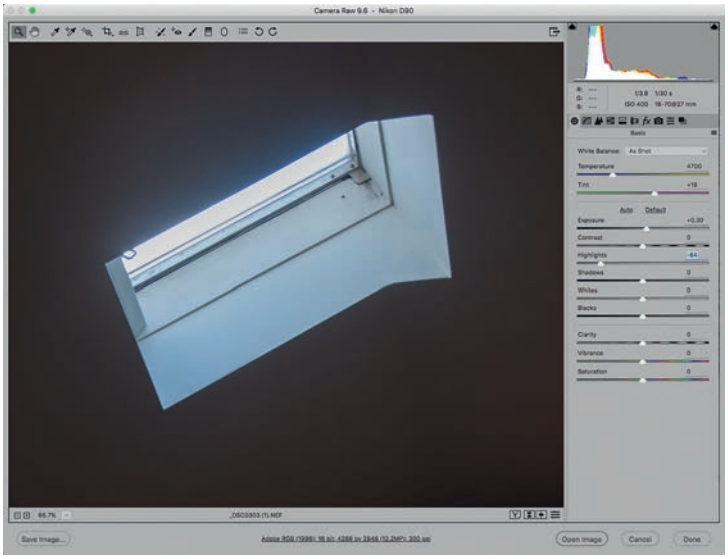

FIGURE 10.50 Detail—high-contrast digital image—after highlight recovery exposure adjustment.

Moving the Exposure and the Blacks sliders to the right makes the middle and shadow values lighter, but the highlights retain their detail.

After a few other small adjustments, the result is a greatly improved image that can now be converted into a form that can be fine-tuned and edited in Photoshop.

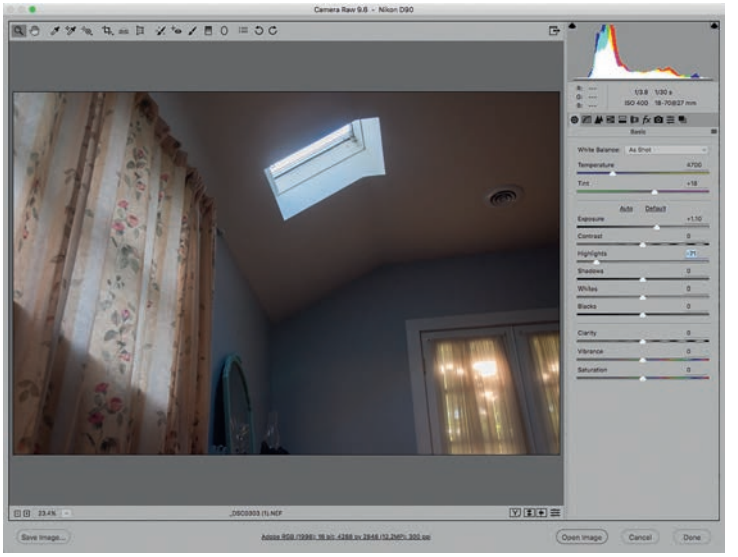

FIGURE 10.51 High-contrast digital image after highlight recovery and exposure adjustment.

Remember that this process works only on images shot in raw format.

High Dynamic Range (HDR)

The relatively limited capacity of current digital sensors to capture detail in very high-contrast subjects has inspired a number of different software developers to create applications designed to deal with this problem. What all of them have in common is that they attempt to extract image detail from a number of bracketed exposures of the same subject and combine them into one composite that appears to be a single image with a very wide tonal scale.

When HDR workflows first appeared, it was true that they generally worked best with images of subjects where there were no moving elements. More recently the utility and popularity of HDR has encouraged developers to greatly improve the range and functionality of the software so that now there are beautiful techniques you can use for subjects with elements that are in motion.

There are a number of talented artists who have produced dramatically stylized, powerful, and movingly surreal bodies of work using High Dynamic Range (HDR) methods. A great example is the work of Dan Burkholder, whose work is included in Appendix V.

HDR has also been integrated into many of the most popular digital editing applications and, given that sorting, organizing, and applying HDR methods are all steps in the workflow, it makes sense to demonstrate this technique with Adobe Lightroom that combines all of these functions.

Figure 10.52 shows an example of an image with a dynamic range of 14 stops from the dark shadows in the corner, which is previsualized as Zone II, to the white areas in the sunlit window on the left that I want to be Zone VIII. (The 14-stop range is based upon spot meter EV readings.) This is clearly far beyond the range of contrast that can be controlled using normal digital processing techniques.

FIGURE 10.52 Very high-contrast digital image.

The following are the steps for creating an HDR image using the current version of Adobe Lightroom.

[Step 1]

Using a tripod, make a series of bracketed exposures that cover the entire range of densities from far overexposed to drastically underexposed. It's best to use your shutter speeds for these brackets because aperture brackets will change the depth of field, resulting in images that will not combine as readily. Unless you're experimenting with the effects of blurred motion, attempt to avoid having objects move during the exposures with longer shutter speeds.

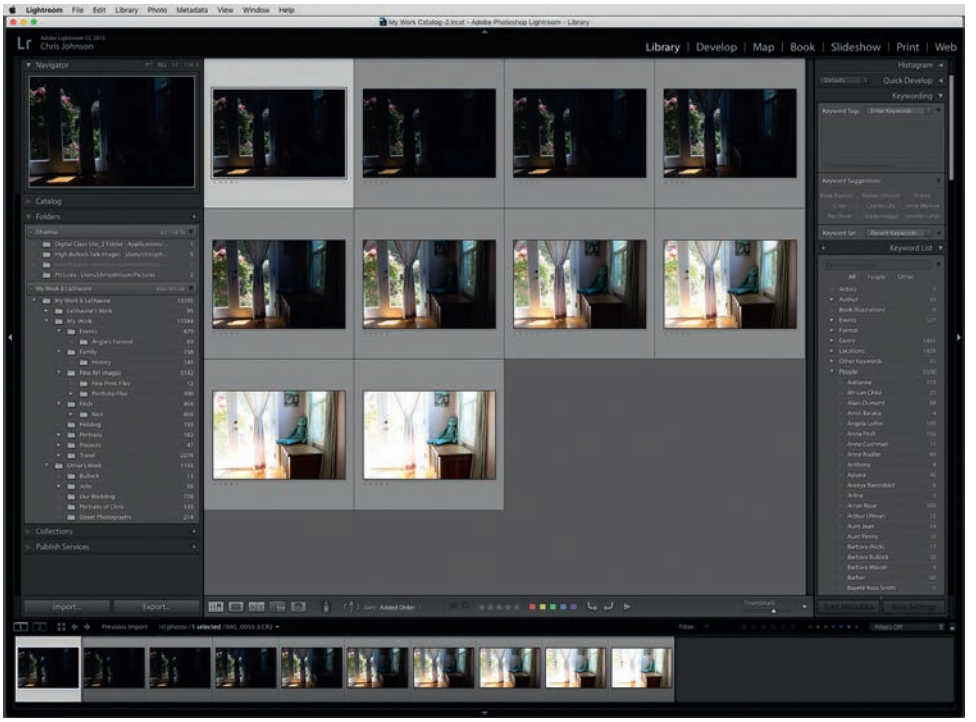

FIGURE 10.53 Bracketed exposures in Adobe Lightroom.

Figure 10.53 shows 10 of these bracketed exposures that were shot in raw format and were imported into Adobe Lightroom.

[**note**] Lynda.com is an excellent online resource for learning the details of how to use Lightroom to import, sort, keyword, rename, and catalog your images.

The more images you use to create the composite, the more digital information you have to work with and, in theory, the more likely you are to get better results.

There are a number of important advantages to using Lightroom for this process. For one thing, the powerful Camera Raw converter built into Lightroom gives you the option of making non-destructive modifications to your images either before or after they are merged into one

HDR raw file. Essentially what you are doing is dramatically extending the range of the raw conversion adjustments you can make to the resulting composite image.

In this example I will make the necessary raw adjustments after the 10 images have been combined into one.

[Step 2]

Select all the images you want to combine and then choose Photo Merge > HDR from the Lightroom Photo menu.

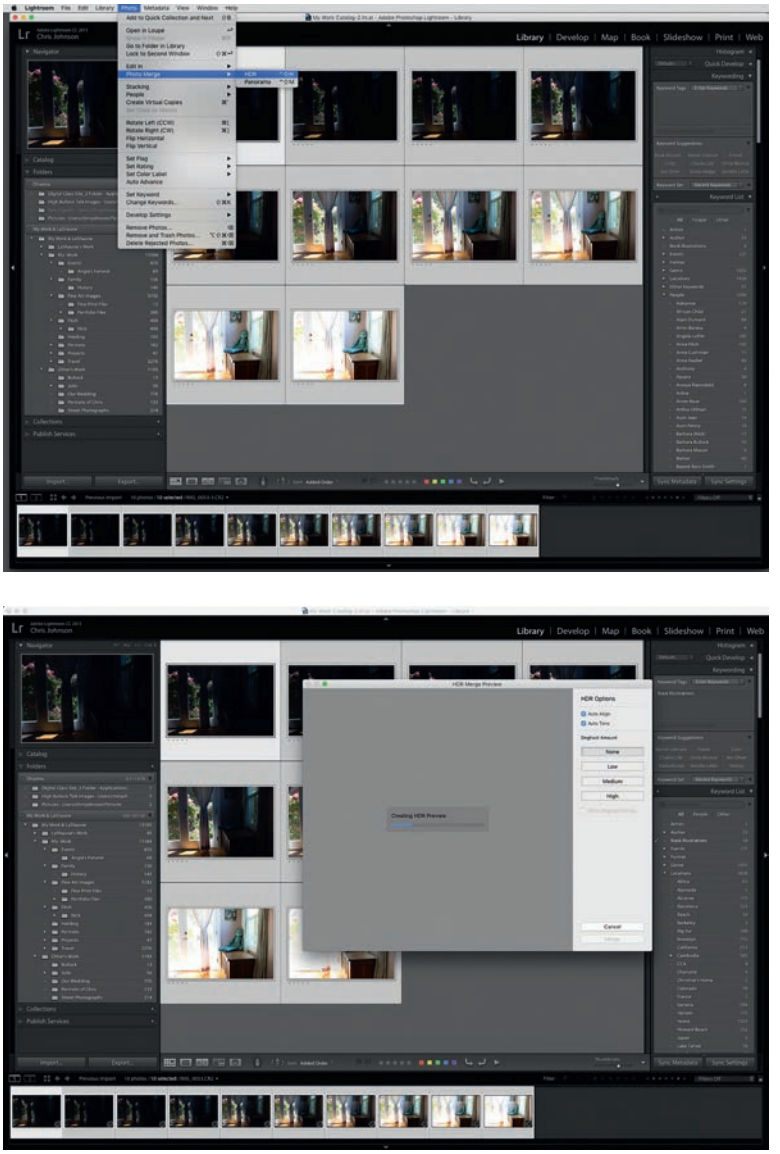

FIGURE 10.54 Merging raw images to HDR.

[Step 3]

When your image appears in the HDR Merge Preview window, you will notice that, while it does contain detailed image information at both ends of the tonal spectrum, it may also be darker and more flat than you intend for the final image.

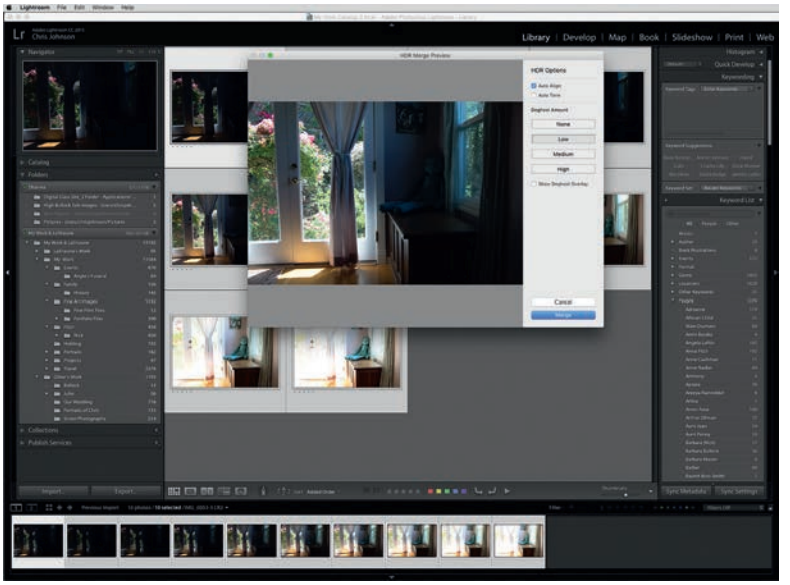

FIGURE 10.55 Preview of HDR merged image.

Click the Merge button and the preliminary version of your composite will appear in Lightroom's Library.

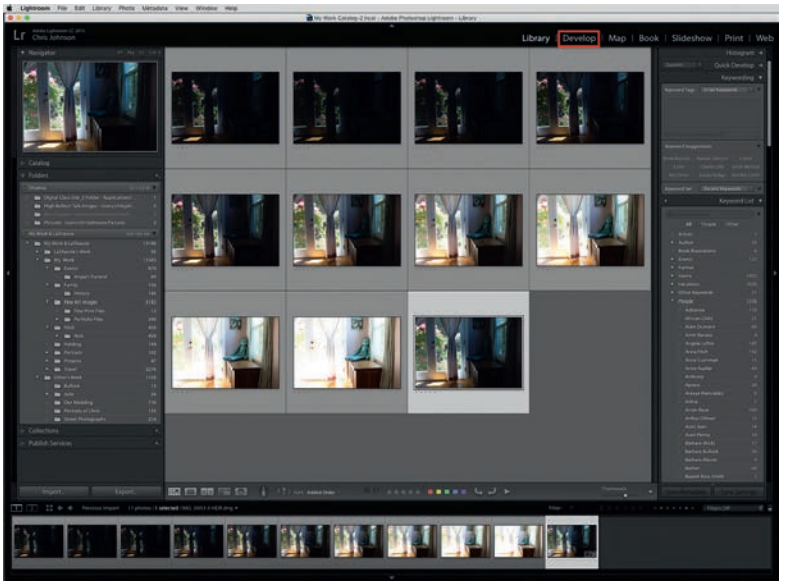

FIGURE 10.56 Merged HDR image in Lightroom Library.

[Step 4]

The next step is to select your new image and click on the Develop Module button. Note that this new composite is still a raw image and Lightroom's Develop Module gives you control over the image's exposure, color temperature, contrast, and tonal levels in ways that cannot be duplicated in Photoshop.

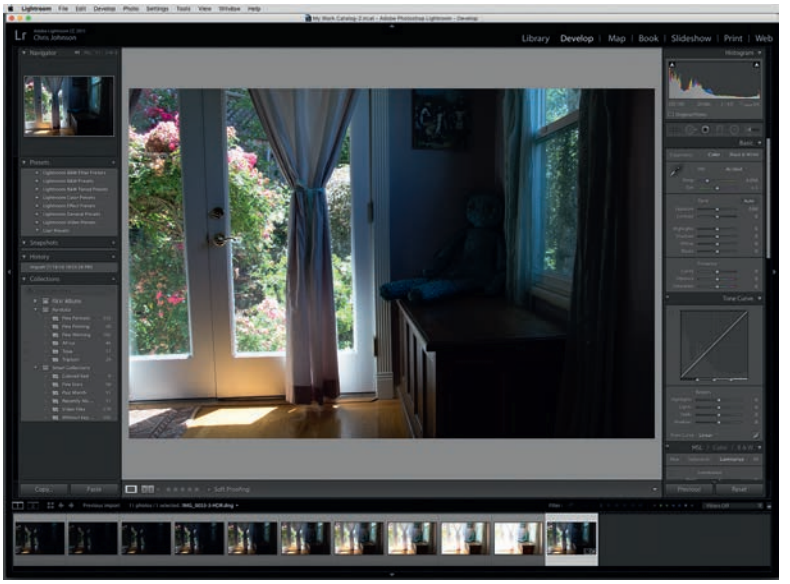

FIGURE 10.57 Merged HDR image in Lightroom's Develop Module.

FIGURE 10.58 Merged HDR image after Lightroom's Develop Module adjustments.

[Step 5]

When you are done, return to the Library Module select your new image and Control click on it to open it in Photoshop.

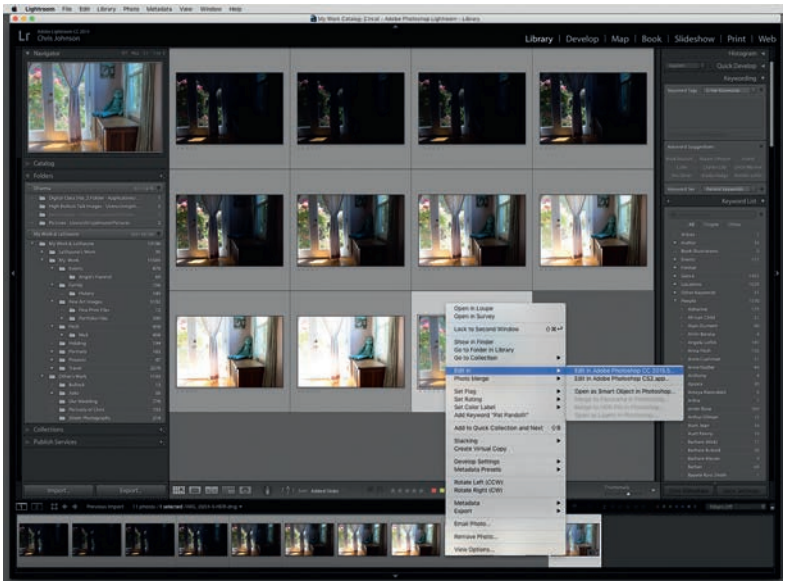

FIGURE 10.59 Open the HDR Image into Photoshop.

[Step 6]

When your merged image opens in Photoshop you can further refine the dynamic range of your image by adding a Levels Adjustment Layer and experimenting with the White, Black, and Midpoint sliders.

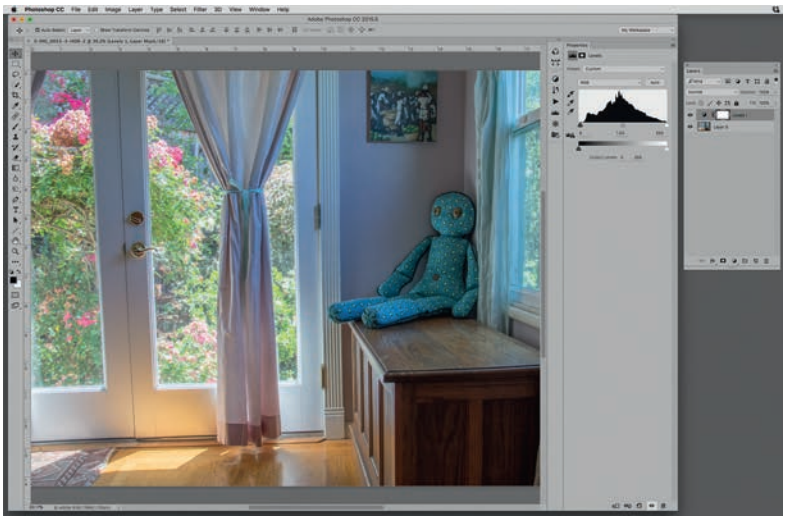

FIGURE 10.60 Making Levels adjustments to your merged image.

[Step 7]

After you crop burn, dodge, and perform other normal Photoshop editing steps carefully sharpen your image.

[**note**] Sharpening is always required for digital images and is, in fact, almost an art form unto itself. There are many specialized applications that do an excellent job, and the best ones even offer different sharpening standards and methods for different output choices. (See Appendix X for references to my favorite sharpening applications.)

Adobe Photoshop sharpening works by increasing the contrast between tonal edges. High Amount settings push the tones on either side of edges further apart. Low Radius settings decrease the distance on either side of tonal edges. In the Unsharp Mask tool, Low Tolerance settings decrease the difference between tones that Photoshop considers a tonal edge.

Always sharpen with the image set to 100 percent and be careful to avoid oversharpening.

Your result will be a refined digital image with far greater dynamic range than could have been achieved without HDR techniques.

FIGURE 10.61 Final HDR image.

FIGURE 10.62 The HDR process.

Again, don't be surprised if this technique doesn't always result in perfectly convincing final images. Until the native dynamic range of digital sensors improves dramatically, all of these remedies will be better for creating interesting visual effects than for offering perfect solutions to the problem of photographing very high-contrast images.

Summary of Digital Photography Cardinal Rules

This chapter contains many principles, suggested techniques, and working methods that together will help you produce better photographs with your digital camera.

I highlighted the following five Cardinal Rules because they are easily overlooked, and if you do nothing else, these recommendations will greatly improve the quality of your work:

- **Always use the lowest ISO possible with digital cameras.** The ability to change ISO settings from one frame to the next is an important advantage of digital photography. Most photographers are familiar with photographic grain, and some even use it to great aesthetic advantage. The same could be said of digital noise, but if reducing it is your goal, then this rule is the key.
- **Always shoot in raw format unless you are certain that you will never need the visual information stored in the raw digital file.** Camera Raw files contain not only much more visual information than JPEG images, allowing for larger, higher-quality prints, but also contain useful metadata and make it possible for you to take advantage of raw conversion software. Unless image storage space is a priority and you are sure you will never need the advantages that raw files provide, this rule is always the best practice.
- **Scan or capture for your largest final print size and never interpolate if you can avoid doing so.** When scanning, always determine the largest image size you ever intend to make and use that as your output size. The resolution should always be at 300 dpi if your goal is to make a high-quality inkjet print.
- **Expose for the highlights and process for the shadows. (Also known as: Expose to the Right.)** This is the general guideline for optimizing digital exposures. It helps you avoid banding by reducing the need for contrast adjustments and places your shadow values as far away as possible from the darker, pixel-level-deprived end of the histogram.
- **If you are shooting raw image files, do as much image correction as possible during the raw conversion stage of the process.** Because of the digital linear effect, raw images are fundamentally different from the same images after they have been converted into tone-mapped files. Raw conversion software, and especially Adobe's Camera Raw utility and/or Adobe Lightroom, takes advantage of this process, allowing you to control factors such as image exposure and color temperature in ways that are impossible to reproduce with Photoshop.

FIGURE 11.0 Nude, Campden Hill, London, April 1949 by Bill Brandt.

chapter **eleven**

The Zone System and Studio Photography

About Bill Brandt's Photograph

The photograph that serves as the key example of this chapter is titled "Nude, Campden Hill, London, April 1949," a masterpiece of tableau photography by an artist who is an inspirational favorite of mine and also of Ansel Adams. I know this because the last original print I saw of this photograph was on Ansel's wall in 1983, a year before he died.

Much more of Bill Brandt's work can be seen at the website of his Archive at www.billbrandt.com/. Reproductions of this and limited edition fine prints can be purchased from his estate.

Although Bill Brandt did not use the Zone System for the creation of his image, the lighting techniques he employed were highly sophisticated and would represent a considerable challenge for anyone attempting to use controlled lights to establish mood and aesthetic emphasis in a studio setting. This is precisely the problem even skilled professionals encounter in commercial studios in all parts of the world.

My re-creation of his work is titled "Homage to Bill Brandt." As you will see from your viewing of Bill Brandt's vast body of historic and classic work, he was a visionary master. My photograph is a humble tribute to his influence.

Introduction

Ever since the beginnings of photography in 1839, photo-image makers have had, in very general terms, two significantly different ways to create meaningful pictures.

The first was something radically new at the time. Let's call it the Mode of Photographic **Discovery**. For photographers working in this way, relevant meanings were "out there" in the world to be discovered through a process of investigation, perhaps travel, and then careful and accurate rendition. In this broad conceptual sense, both landscape and documentary photographers can be described as working within this mode of expression, and until that moment, with the possible exception of descriptive writing, artists had no other ways to extract meanings directly from the visual world. Along with the illusion of objectivity, this was a breakthrough.

In contrast, again from the very beginning, there were photographers who worked within the Mode of Photographic **Fabrication**. This means projecting internal images and fantasies onto the world by creating illusionistic worlds in studios, much in the way a painter or drawing artist does in a free play of imagination.

Portrait photography and the work of artists such as Sally Mann, Larry Sultan, and Philip-Lorca diCorcia, among many others, occupies a middle ground between these two general headings, but let's consider what the Zone System has to offer each of these approaches.

We have seen how the Zone System applies to photographers working in the Discovery mode: It's now possible to look at the tonal value of any part of a subject and know precisely how to translate that into an exposure and development time that will create a negative or digital file that is very easy to print.

This chapter explains how the Zone System can be a very practical tool for working with complex lighting setups in photographic studios. Along the way, you will learn some important basics about flash meters, lighting principles, and how the Zone System can function as a tool for creative visualization in the studio.

One issue that is not often considered is the way Discovery photographers are sometimes constrained by the inclination to simply record the world just as it is. One of the key advantages of working with the Zone System is that it makes it very easy for artists to photograph the world as they *imagine* it, rather than as the way it appears to be. The goal is for photography to become an open creative process with many possible outcomes. An example of this is the image of a beach in Marin County, California, that I used in Chapter 4, "The Zone."

Parts A and B of Figure 11.1 are photographs of exactly the same stretch of beach in Northern California, although many years apart. The image on the left is the way it actually looks, and the one on the right is my interpretation of it using Zone System techniques of previsualization and exaggerated exposure and development.

If alternative or surrealistic interpretations of the world are your goal, it can sometimes be difficult to see past the natural state of things in front of your lens. But consider how this issue applies to photographers working through a process of Fabrication.

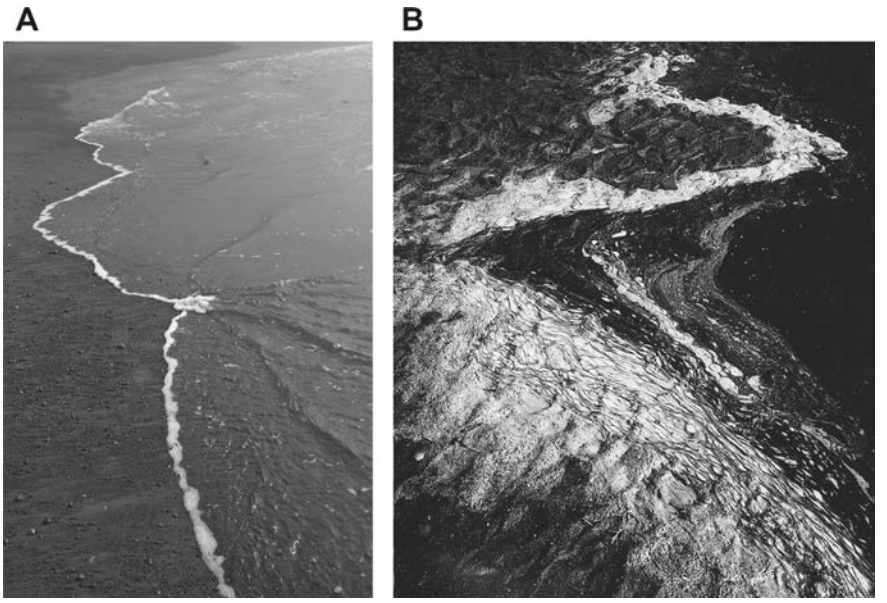

FIGURE 11.1 Two renderings of Muir Beach.

Directorial, or Fabricative, photographers are free to create almost anything they can imagine! And, of course, the range of artists and approaches under this heading is vast. From masters such as Arthur Tress and Jerry Uelsmann who create fantasies from dreams, to Irving Penn and Gregory Crewdson who redefined what it means to work in a studio, Fabricative artists start with acts of imagination and build their artworks from scratch using elements that they both find and create.

What the Zone System can do is provide photographers with a workflow that simplifies the process of previsualizing and manifesting creative visions in studio settings.

Digital Workflow and the Power of the Zone System

Modern digital photographic studios are often equipped with high-resolution digital backs that are tethered to computers and monitors that allow for instant visual feedback as adjustments to composition and lighting are made. In a very real sense, this might seem to eliminate the need for a process like the Zone System. And, in fact, many professional photographers working in studios no longer need or even own light meters for most of their work.

There are still, of course, many studio fine art and commercial photographers who continue to shoot film or are using untethered systems that would make workflows like the one described here very practical. And even the most experienced digital photographers sometimes are confronted with novel situations in which a light meter becomes a very handy tool.

However, the real power and utility of the Zone System in a studio setting is that it allows photographers to visualize and translate sometimes confusing or obscure lighting concepts and treatments into a precise and intuitive visual vocabulary that can be easily converted into light meter readings and exposures.

For example, photographers familiar with the Zone System know that normal Caucasian skin tones fall naturally within the range of Zone VI. Instead of saying, "I'd like her skin to be somewhat lighter than normal" or "Let's make the ratio of her skin to the background 2 to 1," a Zone System–trained photographer could instinctively say, "I want her skin to be Zone VII or Zone VIII." This statement not only has specific aesthetic implications and meanings, it also automatically translates into specific meter readings the photographer can use to position lights and expose the image.

Even saying "Make her skin one stop brighter" is more ambiguous than "Zone VI to Zone VII" because, in the language of the Zone System, these zones refer to specific tonalities that the photographer can see in his or her mind. Plus, we've learned that this change from one Zone to the next automatically means an increase of one stop and a ratio of 2 to 1.

This same process applies to visualizing, positioning lights, and exposing every part of a complex studio-lit tableau.

The Lighting Studio as a Creative Environment

The concept of a "studio" is as fundamental to photographers as it is to a painter or sculptural artist. Working in a studio embodies the seemingly contradictory factors of control and freedom. The reason you are in a studio is so that you have the ability to control all of the elements that comprise the creative process. The subjects, props, background, and lighting are all things you can position and control as if the whole setting were a blank canvas for you to work with. In this sense, the studio becomes a metaphor for the interior of your imagination. The closed door allows you to manifest anything you can imagine and have the skills to create.

HOT LIGHTS VERSUS STROBES

Photographers have many choices for how to equip and work with lights in a studio, and most of the basic concepts you will learn in this section apply as much to using continuous or "hot" lights as they do to using strobes. The advantage of using hot lights is that they allow you to see in advance precisely what the film or digital back will see when the image is exposed. There are, however, some inherent disadvantages to working with continuous lighting sources:

1. They are called hot lights for a very good reason. Tungsten light sources especially become so hot when they are left on that they can easily ignite anything flammable in their proximity, and they can be very uncomfortable to sit under for long periods of time.
2. By far the least expensive and most practical sources of continuous lighting in a photographic studio are tungsten lights, but they are not balanced for daylight as are the sensors in digital cameras and backs. You can convert the color temperatures of tungsten lights to daylight through software relatively easily if you're shooting in camera raw format, but shooting in daylight from the beginning simplifies things.

Although daylight-balanced continuous lighting sources are readily available, they can be very bulky and expensive, such as Hydrargyrum medium-arc iodide (HMI) units.

3. Although tungsten lights appear very bright to our eyes, they, in fact, produce far less light than strobe units, meaning that you are restricted to relatively wide apertures and narrow depth of field.

For all these reasons, this chapter will concentrate on the uses of strobe lighting sources in the studio.

Understanding Flash Meters

Applying Zone System concepts to the process of working with strobe lights in the studio means first understanding how digital flash meters work and then how to translate what they do into the visual language you've learned in the preceding chapters of this book.

For the purposes of illustrations in this chapter, I will be using diagrams based on the Sekonic L-758DR DigitalMaster Flash Meter as my model. There are many very good flash meters on the market, but the Sekonic is extremely versatile because it functions as an incident, spot, ambient, and strobe meter all in one. All the concepts I'll be describing will be easy to translate into applications for meters from other manufacturers.

There are three basic concepts that studio photographers need to understand to make best use of flash meters and the ways they can be used with the Zone System.

1. Only the Aperture Matters

This statement is an exaggeration, but it makes an important point that can be easily understood if you imagine that you are a tiny person, standing inside a camera in a dark lighting studio.

Let's say that the lens aperture is set to f/11 and the shutter speed to 1/60th of a second. The duration of typical studio strobe flashes can be as short as a few milliseconds, so when the shutter is released, here's what you would see:

- First, the shutter opens, but because the studio is dark, you see nothing.
- Then, while the shutter is still open, the strobe fires, and for a very brief time, you see the whole setup in front of the camera.
- After the strobe light disappears, the room is again dark.
- Finally, the shutter finishes its duration and closes.

The fact that the shutter was actually open for 1/60th of a second did not produce any effect on this exposure.

Because the flash duration is so much faster than any shutter, the shutter speed is usually irrelevant for calculating exposures when working in the studio. Other than the strobe burst, the only light source that could have made an impression on the film or digital sensor would have been a light that had been visible the whole time of this exposure. This is why slow shutter speeds become a factor only when you're shooting scenes with light bulbs, windows, or candles that are lit for the whole duration of your shot, or when you are using strobes as a supplemental light source when shooting outdoors.

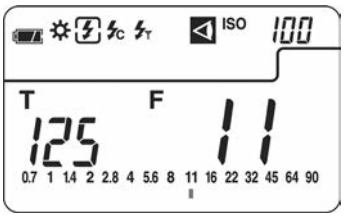

FIGURE 11.2 Typical digital flash meter dial.

Notice that when you look at the dial of a typical digital flash meter, it appears to give special prominence to the aperture rather than the shutter speed.

Of course, the absolute value of this reading also depends on the ISO rating of your film or digital back.

2. Flash Apertures and Distance

So far in this book, I have given great emphasis to the value of using reflected-light meter readings for working with the Zone System. The reason is that our concern has been primarily to know how much light is being reflected from various areas of the scenes we've been photographing. Understanding how to place these readings where we want them to be on the Zone Scale is the essence of the Zone System of exposure.

But, at this point, it's important to note that incident-light meters are extremely useful in studio settings because they measure amounts of light that are falling *on* various subjects on your set.

Incident-light meters have sensors that are under what are called spherical diffusers that look like half of a small ping-pong ball. The diffuser simulates the effect of light falling onto a three-

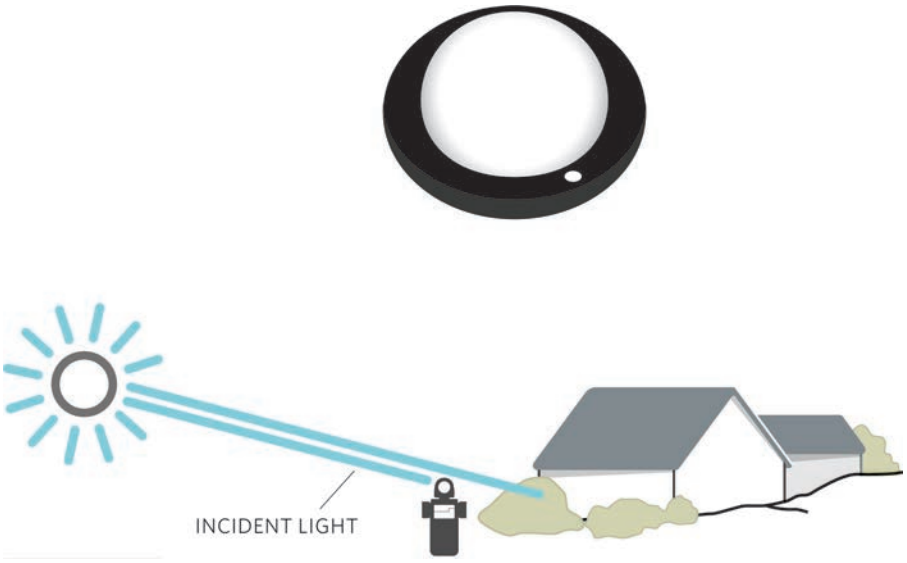

FIGURE 11.3 Spherical diffuser and incident-light meter illustration.

dimensional object, and the meter averages this combination of light and dark to render a Zone V exposure reading.

We saw this illustrated in Chapter 5, Figure 5.1.

This diagram was useful for making the distinction between incident- and reflected-light meters, but now I can point out something that doesn't make sense in this drawing: Although I show beams of light that radiate outward from the sun, I also show oddly parallel beams of light falling on the meter and shrub. The fact is that, other than laser light, all other forms of light spread away from light sources and decrease in brightness in a very predictable way that's illustrated in Figure 11.4.

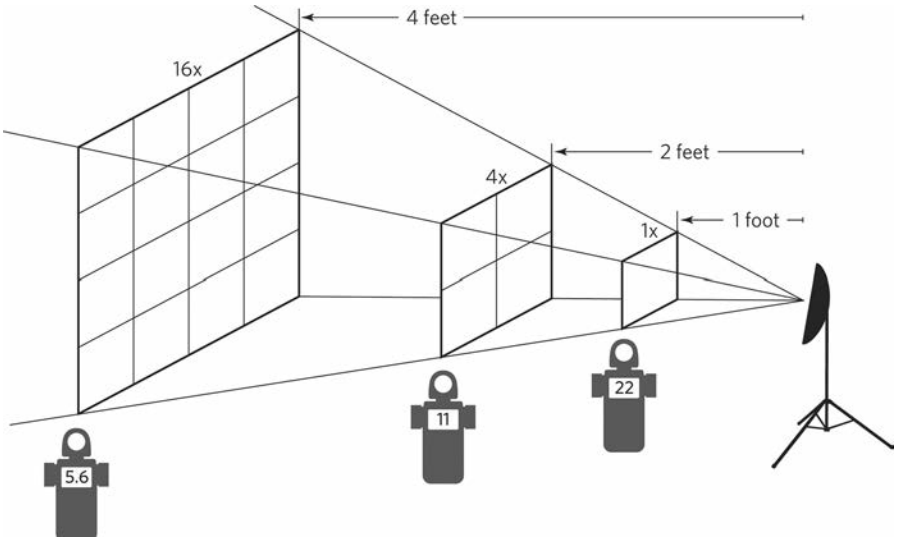

FIGURE 11.4 The Inverse Square Law and apertures.

The Inverse Square Law requires that, *in order to keep the exposure the same*, every time you double the distance between the light source and the flash meter, you have to compensate for the loss of illumination by increasing the exposure by two stops.

One key element of this explanation is the part about **keeping the exposure the same**. Another way of expressing this would be to say that, every time you move a light meter **farther away** from a light source, the brightness of the total amount of light falling on a given area decreases, and therefore the meter **asks for a wider aperture** to keep the exposure the same as before.

Keep this concept in mind.

3. Flash Meter Readings, Zones, and the Key Aperture

The reason that light meters ask for more exposure the farther they are from a light source has to do with the now-familiar fact that all light meters are designed to recommend exposures that render whatever is being measured as a middle gray or Zone V value.

We have also learned that, in lighting studios, flash meters are designed to offer readings in terms of an aperture that corresponds to the distance it is from the light source: the closer the light, the smaller that aperture the meter will recommend.

As I mentioned earlier, all flash meters primarily read out with aperture numbers because the speed of the strobe burst is so much faster than the shutter speed built into the camera.

But, of course, the essential question for taking any photograph is, "What specific aperture should I use for this image?"

When you're taking any photograph, the issue of aperture choice is always only one part of a two-part question. Normally, you would be asking:

1. What aperture should I use for the depth of field I need?

The second part of this exposure question is:

2. What shutter speed should I use that corresponds to this aperture to give me the proper exposure?

But, as we've just seen, in studio photography this second question needs to be replaced with a different question related to the intimate relationship between apertures and **distance** in lighting studios. We will get to that question in a bit.

First, let's consider question #1. As always, the proper aperture for a given image depends entirely on the amount of depth of field required for the key areas of the image to be sharp.

One complicating factor when working in a studio is that it may be difficult to preview an aperture's depth of field because the image on the ground glass simply becomes too dark to see which areas are sharp and which are not.

One handy trick that I often use when shooting in the studio is to create what I call a "magic wand" out of a small ball of crumpled aluminum foil on the end of a long stick.

FIGURE 11.5 Studio lighting magic wand.

Because the crumpled silver ball has many shiny, highly reflective surfaces, it is easy to see specular reflections bouncing off it when a bright studio focusing light is positioned near it anywhere in the set. Even with the lens stopped far down on the scale, the sparkles from the wand make it clear if a given area of the subject is sufficiently sharp.

Using your magic wand, you can easily choose which aperture will be ideal for a given photograph. From now on, we'll call this your **Key Aperture**, and it's important to remember that this is the aperture that your camera lens is set to and that you are actually using to take the picture.

For the sake of this example, let's say that the Key Aperture that we are using to take a given image is **f/11**. To illustrate how lighting *distance* plays an important role in the second exposure question in the studio, let's begin with the most simple example we can imagine. Shortly, we will see how this process applies to a much more complex lighting problem.

Suppose you were commissioned to produce a copy image of what we'll call "The Zone Flag."

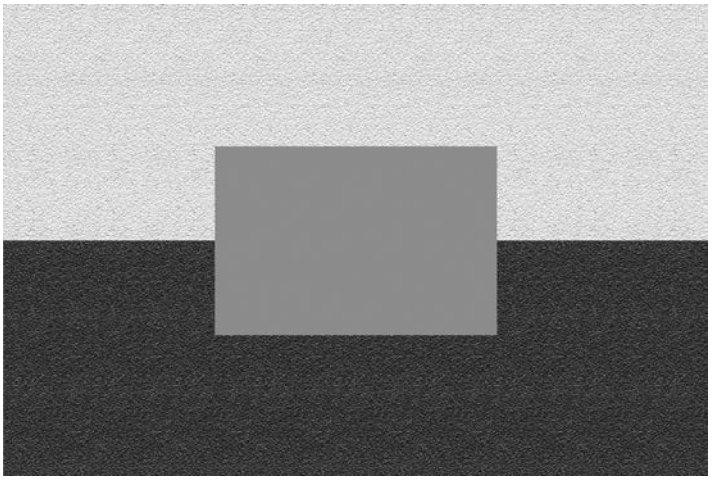

FIGURE 11.6 The Zone Flag.

Treating this as you would any piece of flat artwork you were shooting, you would have two goals, and both would determine how you positioned and adjusted your lights. Your first goal is to make sure that the lighting is even from one corner of the flag to the other. Most likely, you would do this by setting up two broad light sources and positioning them at equal distances on either side of the flag at 45-degree angles. (The trick for doing this is to have your assistant hold a pencil in the middle and move the lights until the shadows on each side are the same length.)

Your second goal is to make sure that your reproduction of this flag perfectly matches the tonal values of the original. It's one thing to know that your lights should be at equal distances from your subject, but the important question is: Exactly how far away should my lights be from my subject?

This is the second exposure question when working in a lighting studio.

The Creative Sketching Process in the Studio

To answer the question posed in the preceding section, you first need to have a way to clearly visualize exactly how you want your subject to look in the final print. Again, you should consider this step in the process as one that is open to your imagination. This is why making a simple sketch is such a good idea: It allows you to visualize many different outcomes before committing to any one of them. This is similar to what painters do with drawings or sculptors do with clay.

When you're done, your sketch will represent your goals for the shoot. In professional settings, this would be done by an art director working perhaps with a graphic designer to create a guide image for the photographer and stylist to work with. You could, of course, enter any placements that you want on this guide drawing, but in this example, our goal is to create an accurate rendition of the Zone Flag.

Understanding the Zone System gives you a very simple way to precisely visualize this final image. Looking again at the original flag in Figure 11.6, you could diagram the way you would want your final print to look like this.

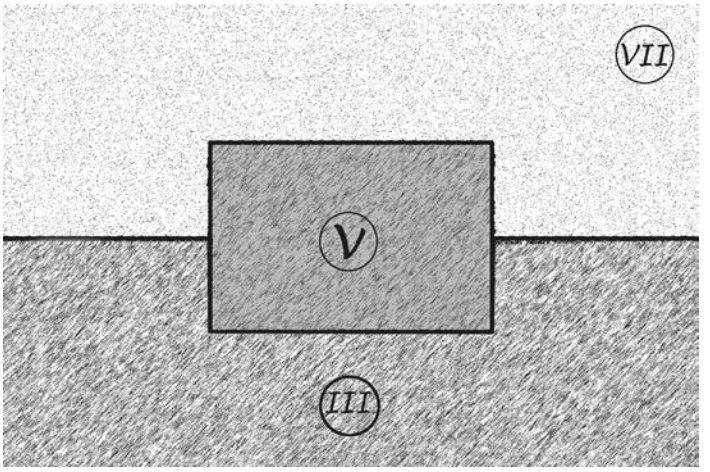

FIGURE 11.7 The Zone Flag drawing with zone placements.

In this diagram, note that:

- The central element is a gray card, so **Zone V** is the obvious placement.
- The upper section is highly textured light gray, so it should be **Zone VII**.
- The lower section is a highly textured dark value (but not black) **Zone III**.

Studio Exposure Methods: Flash Spot and Incident Meters

The following sections describe how you would use a spot flash meter to determine the proper distance for your lights and how you would do the same thing using an incident flash meter.

USING A SPOT FLASH METER IN THE STUDIO

Let me begin by saying that what I'm about to describe is not a very practical method to use in this particular situation. Nevertheless, when we discuss a very complex studio lighting problem later in this chapter, you will see why it's very important that you understand the following procedure.

As mentioned earlier, in this example, we have determined that we need to use f/11 to take this picture so that we have the required depth of field. **F/11 is our Key Aperture for this subject.** In other words, this is the aperture the camera lens is actually set to.

MEASURING SUBJECT CONTRAST USING A KEY APERTURE AND ZONE CHART

Because we know that the spot flash meter will recommend an exposure that renders anything it reads as precisely Zone V, the logical thing to do would be to organize our meter readings on a Zone Chart like the one in Figure 11.8. (A blank version of this chart is available in Appendix U.)

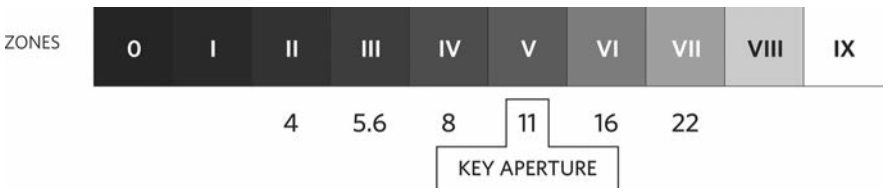

FIGURE 11.8 Spot flash meter readings and Key Aperture on the Zone Scale.

By placing our Key Aperture on Zone V, we are essentially saying that this is the meter reading that we want to get when we meter the middle gray element in the center of this Zone Flag. As you can see, this chart makes the process of comparing your spot meter readings to the tonal values you will want in your final print incredibly easy. (Keep in mind that this is only an example of this process. In any given studio setup, your Key Aperture will be different.)

The next step would be to have your assistant **move the lights back and forth** until, using your spot flash meter in this example, you obtain the following readings for the important parts of this flag. When set to flash mode, your spot meter will read out in apertures; Figure 11.9 shows what the readings could be in this situation.

As soon as you get apertures from your spot flash meter that correspond to these readings, your lights are at the proper distance, and you should use sand bags to make sure they don't move!

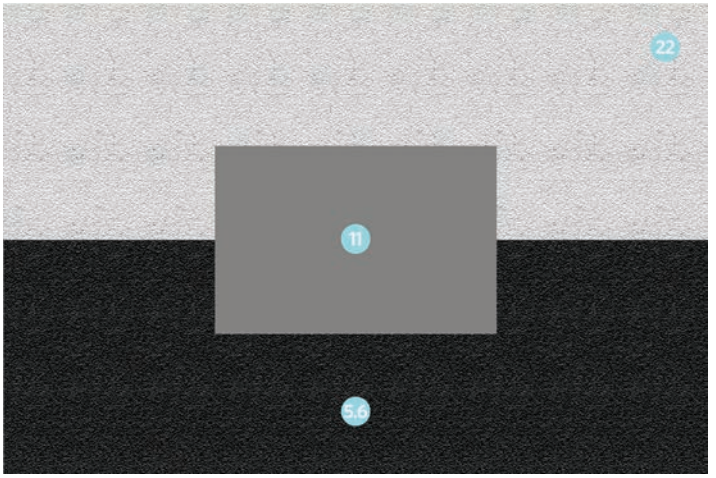

FIGURE 11.9 The Zone Flag with spot flash readings.

You are now ready to take this photograph using f/11 as your camera aperture and 1/60 is usually used as a standard shutter speed with strobes in a studio.

ACHIEVING NORMAL CONTRAST IN THE LIGHTING STUDIO

While you were learning the Zone System in the earlier chapters of this book, your goal was to understand how to manipulate the contrast of either your negative or your digital file so that the variable contrast of your subject would match the contrast or dynamic range of your photographic or inkjet prints.

The lighting studio presents you with very different goals:

- The *art* of working in a lighting studio is having an effective aesthetic vision of how best to fabricate and light your subject.
- The *craft* of working in a lighting studio is knowing how to control the placement of lights and shadows on your subject so that no further manipulation is necessary.

The whole point of using lights in a dark room is control of subject contrast so that reproduction of the negative or digital file is an easy and straightforward process.

If your readings indicate that a part of your subject is too dark, you could move your lights a bit closer. If another part is too bright, you could move that light farther away, or, as is often the case, partially blocking the light will create the necessary result.

[**note**] So far in this discussion, I've been emphasizing the role of distance in determining the brightness and exposure in the lighting studio. But strobe power packs offer you another effective way to control the brightness and exposure of strobes: the watt-second settings on the power pack itself. (See Appendix B for more information about this factor.)

Understanding the Lighting Studio Zone Chart

It is important to understand the logic of how this chart is filled in.

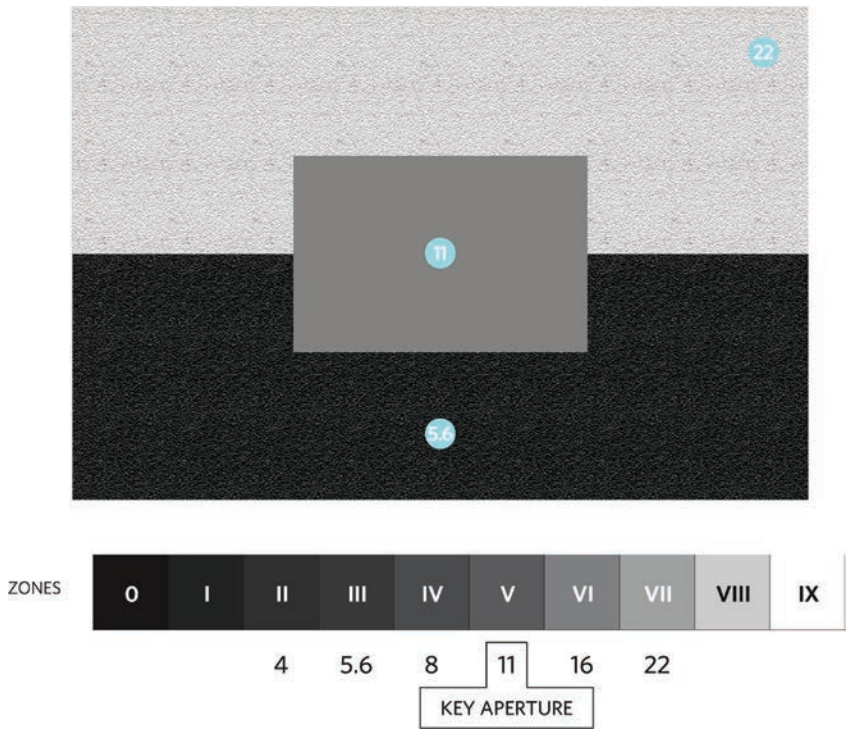

FIGURE 11.10 Zone Flag and Studio Zone Chart.

The Key Aperture is the aperture your lens is actually set to because this gives you the amount of depth of field you need. (Keep in mind that often wide apertures and very shallow depth of field can be aesthetically very effective.)

Once the Key Aperture is filled into this chart, it then becomes very easy to fill in all the other respective full apertures so that you can see where they fall on the Zone Scale.

Using our Zone Flag example: The reason that f/11, the Key Aperture, is entered in the Zone V place on the chart is that it is the flash spot meter reading we got from the gray card after we repositioned the lights. If, again with a flash spot meter, we were then to take a reading of any other part of the flag, we would immediately know how light or dark that area would be in the resulting photograph. With the Key Aperture f/11, placed on Zone V, the chart shows that f/5.6 falls on Zone III and f/22 falls on Zone VII.

Here is an explanation for why this is true: Say you spot meter an area, and the reading is f/5.6. Looking at our scale in Figure 11.10, we can see that this area will end up being Zone III (textured dark) in the resulting image. Why Zone III? What's happening is that the spot meter is asking for f/5.6 to make the area being measured into a Zone V value.

The meter is asking for f/5.6, as shown here.

However, the camera is set to f/11, as shown here.

Because the camera is set to an aperture that is two stops smaller than the meter is asking for, that area will end up being rendered two stops darker than Zone V; in other words, it will be Zone III in the resulting image. This same reasoning explains the placement of all the apertures on the chart in Figure 11.10.

This method and chart provide a very simple way to know *in advance* exactly how light or dark any part of your subject will eventually be. All you have to do is meter that area with your spot flash meter and see where the resulting aperture reading falls on the Zone Chart.

This also translates into a simple rule you can use to understand how spot and incident flash meters work:

- When they read out with higher apertures, the light being measured is brighter.
- When they read out with lower apertures, the light being measured is darker.

Incident Meters Never Lie

I hope that the preceding explanation makes this process of spot flash metering and moving your lights seem like a very logical and practical system, and in complex lighting situations or when digital backs with tethered monitors are not available, this may be true.

But, in practice, there is actually a much more direct and simple way to resolve lighting problems like determining the correct exposure of our Zone Flag or, for that matter, any flat art or simple table top studio lighting setup: Use an incident flash meter and do exactly what it tells you to do.

The Zone V gray card in the middle of this flag makes this a very easy subject to work with using either a spot or incident flash meter. With an incident meter, you can simply take a meter

reading of the light falling on the gray card and use its reading as the correct exposure for a Zone V placement. The advantage of using a spot meter is that it's the only way to measure the tonal values of different parts of your scene so you can make creative adjustments as described before.

Often all you want is for your final print to look as much like your original as possible. If that's the case, not being able to read the individual parts is less important. As described previously, incident meters average the light falling on the spherical diffuser to an exposure that renders that amount of light to Zone V.

Looking again at our Zone Flag, here's how you might diagram the way you would use an incident meter to not only determine the correct exposure for the gray card in the center, but also to make sure that the lighting is even.

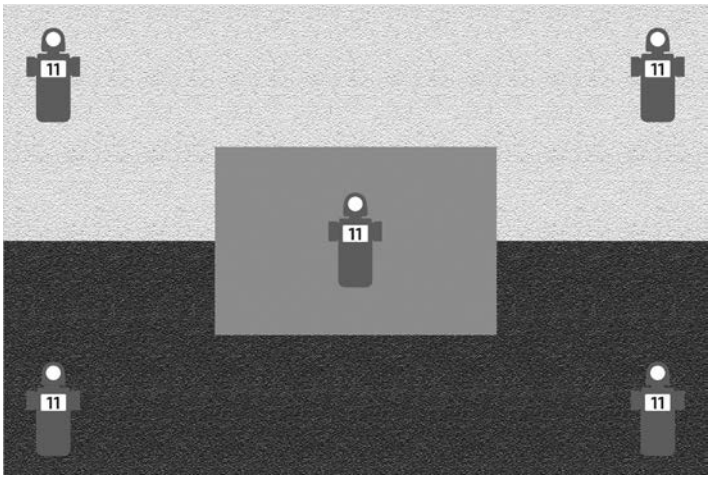

FIGURE 11.11 The Zone Flag with incident readings.

Unlike Figure 11.8 where the spot meter readings were different for different parts of the flag, in this case, the incident meter is completely oblivious to what's behind it. All it can do is measure that light falling on the flag, and this makes it very easy to tell whether one area is lit more than another.

The other implication of this is important to understand, although it can seem counter-intuitive at first: **An incident meter reading that renders a gray card in a given setup as gray, will also render a white surface in that scene as white and a black surface as black.** Just looking at Figure 11.11 makes this concept clear. If the gray card in the image is correctly exposed, all of the other values in that same image will be also.

What this means is that you always have two choices if all you want to do is render things in your lighting studio setup just as they are:

1. You could place a gray card in the scene so that the same amount of light is falling on it as is on the subjects. Then you could take a careful spot meter reading of the card and

use that exposure to take the picture. If you need more depth of field than the recommended aperture allows (you can use your magic wand to check for this), all you would have to do is move your lights in closer or increase the output of your power pack until the meter reads the proper aperture.

2. Alternatively, you could simply place an incident meter in the scene so that the same amount and pattern of light is falling on the spherical diffuser as is on the scene and use that to take the picture. Again, the position or output of your lights may need to be adjusted if you need more or less depth of field. Incident-light meters never lie.

Given what you have just learned, it might seem as if the solution to all studio lighting problems is simply to obey what incident-light meters recommend. The problem is that incident meters are less useful when you're dealing with more complicated lighting situations. They are often very helpful for getting started, but if, for example, you need to know whether one area is *inherently* darker than another and therefore needs more light, you would need a more rigorous way of working. This is where the Zone System and the things that we have learned in the previous sections can be very useful.

The Masterwork Re-creation Process

To demonstrate how the Zone System can be helpful when working with very complex and imaginative studio setups, I've decided to re-create a fabricated photograph by one of the most creative and innovative photographers of the twentieth century.

As mentioned previously, the photograph in this example is by Bill Brandt and is titled "Nude, Campden Hill, London, April 1949." As haunting and moving as this photograph is, there's no mistaking it for something that he simply discovered.

What Bill Brandt has created is an example of a Narrative Tableau that suggests that there is a personal drama unfolding, but one entirely constructed by the artist.

Figure 11.12 is my re-creation of Bill Brandt's masterpiece, which I have titled "Homage to Bill Brandt." (Many thanks go to my friend and colleague Laura Ciapponi for all her invaluable help in the creation of this image. Thanks also to Raina Russell-Shaffer for being a beautiful and patient model.)

There are many good reasons to reproduce masterworks of artists you admire. For one thing, your choice of images to copy says a lot about your own interests and values as an artist.

But most of all, the masterwork re-creation process is a challenging way to study in detail the aesthetics and the technical sophistication of artists whose work you respect. Attempting to step into the vision of an artist like Bill Brandt can teach you a great deal about your own ability to see and feel within a complex and singular creative process. But, most of all, you will learn a tremendous amount about critical formal and technical methods that can enrich your own work.

FIGURE 11.12 Re-creation of Bill Brandt's Nude, Campden Hill, London (*by Chris Johnson with Laura Ciaponni*).

Some Comments Regarding Equipment and Workflow Equipment

Bill Brandt used a customized camera and continuous light sources to create his famous series of nude tableaus, and he certainly did not use the Zone System. Contemporary studio-based photographers still utilize continuous, or "hot," lights for special purposes, but for a number of good reasons, they are much more likely to use electronic strobes as light sources for their work.

One reason is that strobe lights are considerably brighter than hot lights, allowing for the use of much smaller apertures and greater depth of field when that is required. In this case, that was essential because we were not able to stop down to the extremely small f/stops that Brandt used for this series.

Steps in the Process

Note that, for teaching purposes, what follows is an idealized version of the process we actually used to create this image. Working with a live model and needing to adjust to changing variables makes for a much more complicated process than is described here.

[**Step 1**] Building the Set

Given the elaborate nature of this image, the first thing that Laura and I needed to do was assemble, or create, all the component parts of this tableau, which included actually constructing the walls, ceiling, bed, and ornaments of the room.

[**Step 2**] Analyzing the Lighting Treatment

Looking carefully at the patterns of both the attached and the cast shadows in Bill Brandt's original image, we were able to determine both where and what size each light needed to be.

[**note**] Bill Brandt's image is a masterpiece and, to a large extent, there remain some mysteries about how it was actually created. The following diagram simply represents the solution we came up with for the image we worked together to make.

Figure 11.13 illustrates the lighting arrangement we used for this image.

(See Appendix B for a discussion of how using lighting for effective surface rendition and shadow patterns can help in the analysis of studio images.)

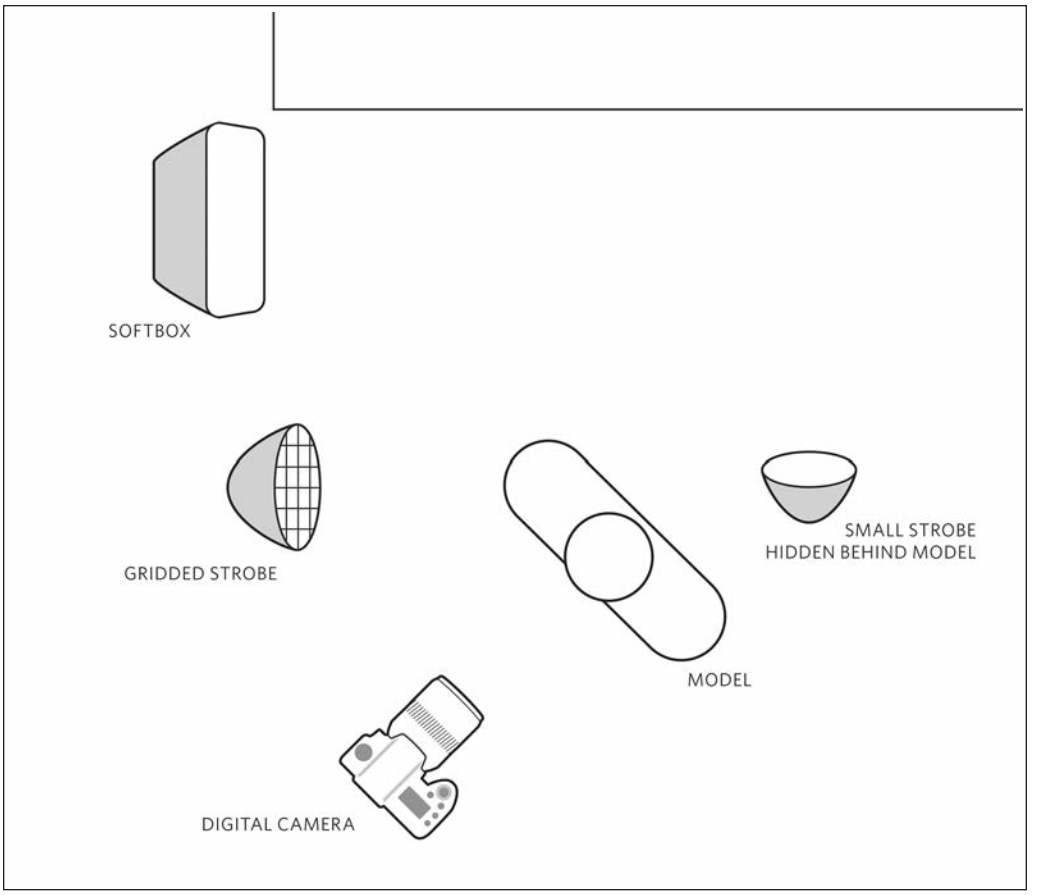

FIGURE 11.13 Set and lighting arrangement for "Homage to Bill Brandt."

[**Step 3**] Previsualizing Tonal Values

The next important step for any serious studio lighting project is to translate the tonal values of the image into the key zones we would be using to refine both the specific placement and intensity of the lights.

It is always a good idea to begin studio-based photographs with a rough drawing to help you organize your composition and resolve any conceptual problems before you begin styling and shooting. As discussed earlier, this is the step in the process that becomes a challenge to your creative imagination. You could simply attempt to reproduce the objects on the set just as your eyes see them. Or, you could push the representation of your subject to whatever degree of abstraction or exaggeration that you believe most effectively conveys your expression.

The advantage of thinking in the language of zones at this stage is that there is no limit to what you can imagine. A surface that is Zone III to your eye could become Zone 0 on your drawing. Recording the zones on paper becomes an act of visualization that amounts to a precise blueprint for upcoming steps in the process.

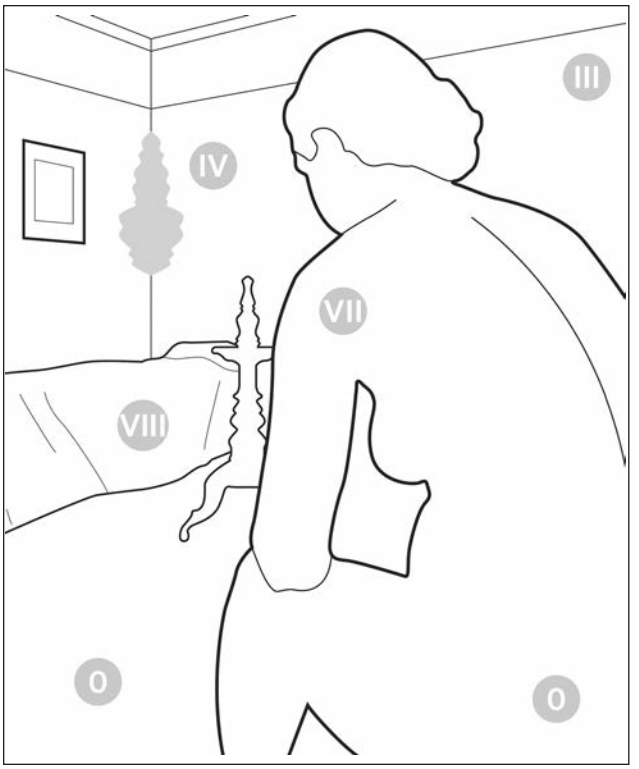

FIGURE 11.14 Zone placements for "Homage to Bill Brandt."

Because in this demonstration we are using Bill Brandt's original image as our guide, this step means assigning logical zones to the key areas of the tableau. Figure 11.14 illustrates the zone placements we will use for this example.

Note that all the zone placements of this image represent our attempts to reflect the mood, drama, and intensity of Bill Brandt's original image:

- The model's skin tones are placed on Zone VII, one zone higher than a normal rendering.
- The floor and lower wall are placed on Zone 0 so that they will function as black, negative spaces within the composition.
- The bed is placed on Zone VIII so that it balances the figure and becomes a brilliant focal point within the frame.
- The upper wall is placed on Zones IV and III to maintain the somber mood of the tableau.

[**Step 4**] Determining the Key Aperture

We knew that we needed as much depth of field as possible, but we were also using a very wide angle lens and, for reasons that will be clear shortly, we determined that a Key Aperture of f/16 would work well for this shot.

[**Step 5**] Filling in the Studio Zone Chart

Figure 11.15 shows the way the layout drawing and Studio Zone Chart would look for this image.

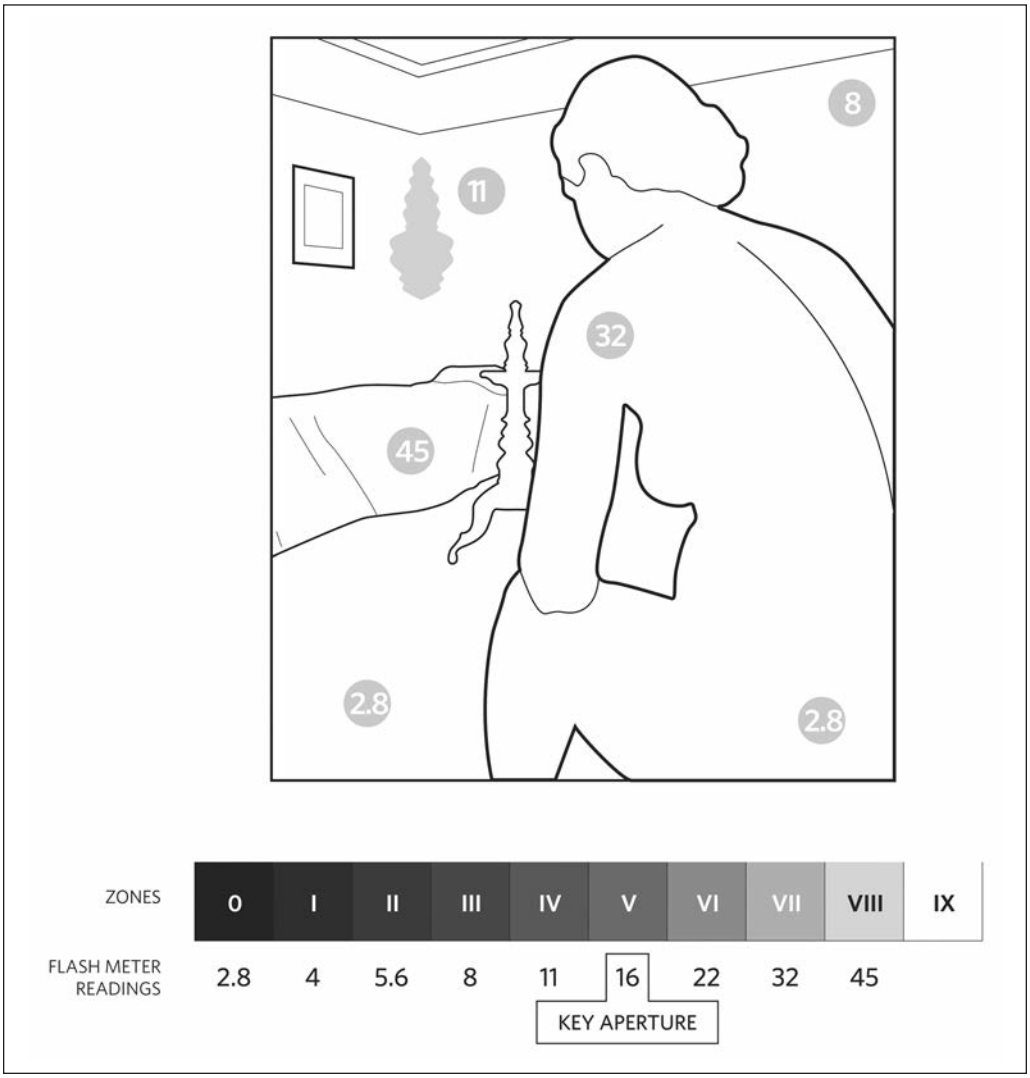

FIGURE 11.15 Zone placements and zone chart for "Homage."

[Step 6] Determining the Meter Readings

To say that the next step was setting up the lights so that we derived meter readings that corresponded to the Studio Zone Chart would be to dramatically understate a very complex process. Some of this step involved choosing materials that would naturally facilitate the placements we needed. For example:

- Using black paper for the floor and wall behind the model's body.
- Painting the walls and molding so that they matched the treatment we wanted.
- Of course, choosing a white sheet for the bed.

But the most important part of this step in the process was determining which lights of what size needed to be placed at specific distances to create the effect we needed. Having a very good predetermined sense of what we were attempting to re-create in terms of zones was extremely helpful, but we also needed to test different exposures via the digital camera we were using.

Both incident and spot meter readings are often necessary for complex shots like this. As we learned previously, incident meters can be trusted to give you a starting point exposure for parts of the subject that are nearby.

Spot meter readings are helpful for measuring the brightness of areas that are smaller, farther away, or otherwise not easy to reach. In every case, a combination of adjusting the output of the power pack and moving the lights back and forth eventually resulted in the balance of readings that we needed.

Summary of Preceding Steps

Before moving on to the details of how the shooting process for this specific image unfolded, let's summarize what we have done so far.

We have learned that three factors are central to this process:

- **Distance:** First between light sources and the subject. The importance of distance is derived from the Inverse Square Law and must be accounted for so that meter readings and exposure make sense.
- **A Key Aperture:** This is specifically related to amounts of depth of field and the degree of sharpness your photograph needs to be effective. Sometimes very shallow depth of field is by far the most evocative way to see an image. At other times, overall sharpness is essential. Either way, your Key Aperture embodies this aesthetic decision.
- **Zones:** The zones connect what you can see and imagine to images you can easily print.

All these factors can be integrated into a seamless whole in the process of creating a lighting studio photographic statement.

There are three steps in the conceptual, formal, and strictly technical process of creating a complex studio lighting project that can come together in the final image.

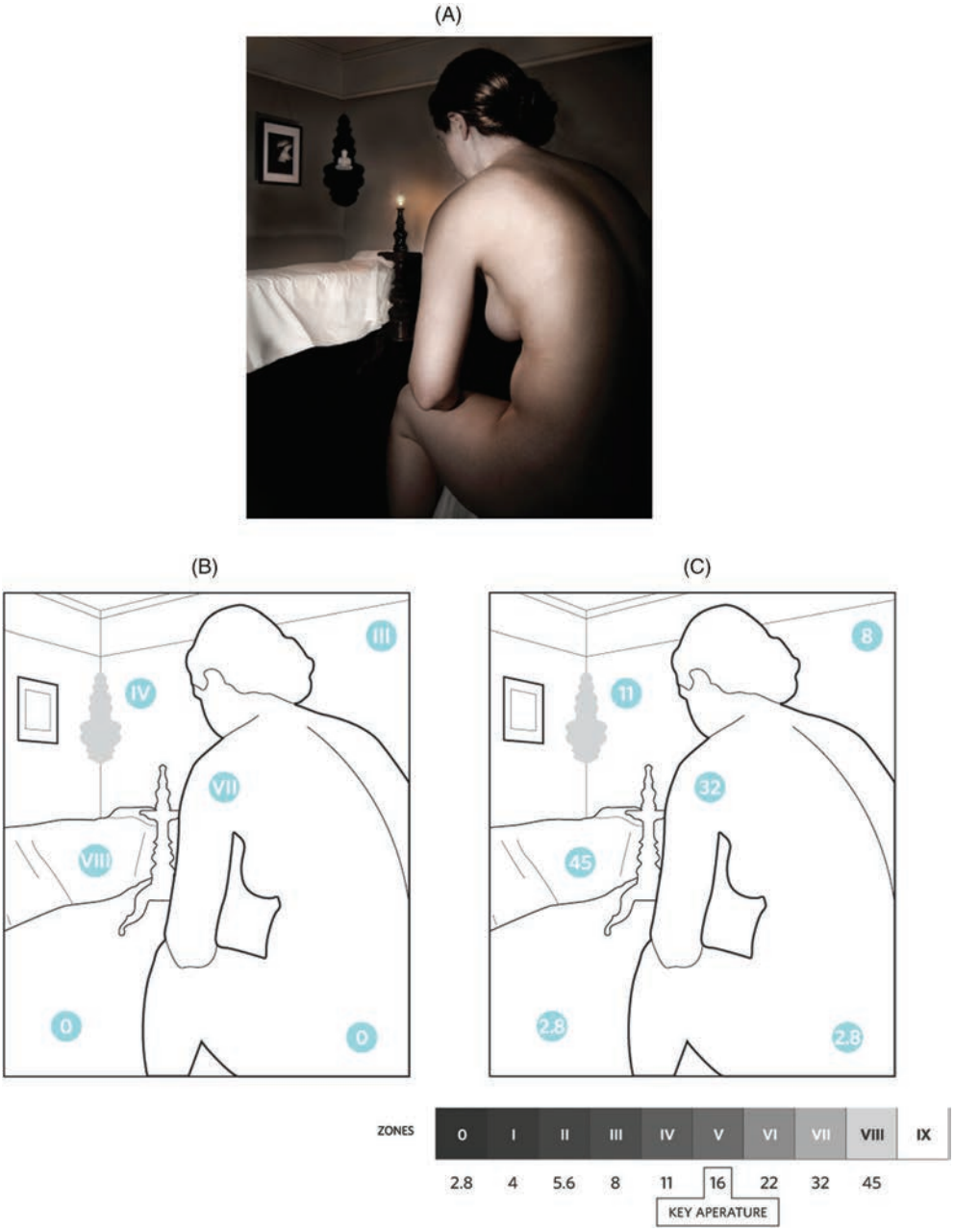

FIGURE 11.16 The three phases of a studio lighting creative process.

A. THE VISION

Every studio photograph is to some extent or another a visualized story. Even the most prosaic-seeming image of an empty glass is saying something about what came before and what might come after the slice of time we are seeing. In the example cited here, the narrative tableau is one derived from the inspiration of a great artist, Bill Brandt. Your challenge is to make your visions of photographic meaning as evocative as you can.

B. THE VISION TRANSLATED INTO ZONES

The recording of your initial vision of the image into Zones is a powerful step. Zones are visual tonal entities, but at the same time, they embody specific technical factors that are functional for the creation of any photographic image you choose to make. There are no limits to what you can visualize in your imagination, but, when those mental images are translated into zones, you can be sure that your vision will be easy to render.

C. THE TRANSLATION OF ZONES INTO METER READINGS

Having a map of specific meter readings, derived from the zones, means that you are ready to begin the process of actually taking the photograph.

The Shooting Process

PREPARING

Careful and detailed preparation is the key to any successful studio shoot, but this is especially important when you're working with models. The ideal would be to have the set so well prepared that the model could simply step into the frame to be photographed. In real life, things are seldom this simple.

In this case, Laura and I worked out all the basics of set creation and lighting as described previously, but it still took quite a while for me to internalize the language I would use to direct our model so that the precise combination of posture and temperament could be fully present and resolved at the moment I released the shutter.

SEPARATING THE BACKGROUND

One key element of the lighting design was something very common for elaborate in-studio photography setups: **foreground and background isolation**.

It is often essential that the light that fully illuminates the key element nearest to the camera does not cast any light on elements that are farther away. This allows you to essentially combine two completely different lighting setups into one seamless image. And, as you will see, for the creation of this image, we, in effect, were working with three combined lighting arrangements in this photograph.

We have seen how the Inverse Square Law can work very effectively to ensure this effect. Consider what happens when one light is falling on the model.

As you can see in Figure 11.16, the spot flash meter reading of her shoulder is asking for f/32.

The meter is of course trying to render her skin as Zone V with this recommended aperture.

In this image, the lens is set to our Key Aperture of f/16.

This is why her skin shows up as two zones brighter than Zone V: Zone VII.

But consider what aperture would have been required for this one light to render the background as visible: The bed is at least 10 feet away from the model so that a meter reading from this one light at that distance might have been f/2.8.

With only one light falling on the model, your meter reading of the bed in the background is asking for f/2.8.

But instead your Key Aperture is f/16, as shown here.

In other words, if we were to only have used this one light, the figure would be brightly lit and the background would be completely black! This is why we needed two other lights to illuminate the rest of the "room."

LIGHTING THE "ROOM"

So far, imagine that the model is powerfully lit by one strobe head with a grid over its face that's positioned very close to her shoulder.

[**note**] A grid is a honeycombed attachment to the flash head that has the effect of channeling the light into narrow bands, making the light very focused and hard. (See Appendix B for more information about hard versus soft lighting effects.)

The model is lit, but the rest of the studio is very dark. In Zone System terms, the goal of the rest of this step would be to bring the brightness of the bed up from Zone 0 to Zone VIII. This required two additional lights: one a normal, broader light and one a small, harder light. The specific position of these lights was determined by carefully evaluating the needed exposure and shadow patterns.

ACHIEVING THE FINAL LIGHTING EFFECT

At this point, you can imagine that there are at least two different lighting treatments combined into the single image that resulted: one for the model and another for the bed and walls. But, if you look carefully, you can see that there is one other essential element of the lighting of this tableau: the candle.

Earlier in this chapter, I used the example of the way a long shutter speed would look from the point of view of a tiny being inside a camera during a strobe photographic exposure. To review:

- The room is dark.
- The shutter opens, but because the room is pitch black, you still see nothing.
- The strobe fires and, for very brief moment you can see all that is visible in the room.
- The shutter closes, and the exposure is over.

I used this thought experiment to illustrate why shutter speeds are generally not a factor for determining effective exposures when you're shooting with electronic strobes. But recall that I also cited instances when anything generating light during the whole of the long shutter exposure would, in fact, make an impression on the film or digital sensor.

This is a good moment to remind you that in Latin the word "camera" means "chamber" or "room."

What Laura, the model, and I experienced during this shoot was essentially equivalent to being in the middle of that thought experiment.

With the lights on, I carefully positioned the model and made sure that the lens was focused properly and that the aperture was set to f/16.

- The candle was lit.
- The lights were turned off so that, except for the dim light from the candle, the studio was completely dark.
- I asked the model to prepare herself for the exposure and then opened the shutter.
- With the shutter open, the digital sensor could see only the candle and began recording its glow.
- The strobe fired, and for very brief moment, we could see the model and the whole set.
- The shutter remained open for a total of 15 seconds.
- The shutter closed, and the exposure was over.

The warm glow of light on the wall and, most especially, on the model's body is the result of this procedure. This is how "Homage to Bill Brandt" was created.

FIGURE 11.17 Homage to Bill Brandt (*by Chris Johnson with Laura Ciaponni*).

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Appendices

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Appendix **A**

Color Management, Profiles, and Color Spaces

I didn't really appreciate how efficient and inspiring digital photography could be until I produced the first print after color managing my system. Before that, I was never sure that my monitor was a reliable tool for editing and previewing my work. After color management, digital printing finally began to make sense and felt like a creative process.

"Color management" is the general term used to describe the coordination of the key elements of digital image processing that allows for consistent color rendition from one step in the process to the other. Without proper color management, you can't be sure that color is accurately displayed on your monitor or that the resulting prints you make will match what you see on the screen. An ideal process would allow you to make one fine print after another without wasting time and materials on trial-and-error adjustments.

Although the technical details behind color management are complex (and beyond the intentions of this book), the process itself is fairly simple to implement if you understand some of the basic concepts involved and know how to apply them to the various tools you'll be working with in digital photography. If you are looking for a comprehensive book on this subject, consult Appendix W for some excellent references.

Profiles

Many of the best books on this subject refer to the now-classic illustration of why color management is important and why color profiles are the key to making digital photography consistent and efficient. We've all had the experience of walking into an electronic appliance store and seeing an array of color TV sets for sale. They are all playing the same demonstration

program, and yet the colors from one screen to the next are sometimes wildly different. Let's consider why this is true.

In general, two things make each TV set unique. First, there are settings that control the brightness, contrast, and saturation of each set, and they are all different. But even if these settings were the same, the phosphors that produce the colors in the screens are all slightly different in the way they respond to the signal from the media source. If your goal is to create a way to ensure that all the displays look the same, you would need to follow these general steps. For each step, I'll make reference to how this stage in the process corresponds to color management in digital photography.

1. First, you would need to decide on what the "correct" rendition of the media source looked like.

In the world of digital imaging, this agreement on what the ideal rendition of all colors should be was done by the International Color Consortium (ICC) with representatives from all the leading manufacturers of digital hardware and software. Together, they created something called the Profile Connection Space (PCS), which is simply an unambiguous mathematical description of what "red" and every other color humans can see should look like.

2. The next thing you would have to do is accurately measure, or "characterize," the color renditions of each TV set to see how it differed from the agreed-upon PCS standards.

Characterizing is the first step in the process known as "calibration" in the digital world. In practical terms, this is generally done in two ways. One is manually using either the Apple Display Calibration Assistant or Adobe Photoshop's Gamma software. I don't recommend that you use either of these because they rely on the human eye to make subtle comparisons, and this is a process that should be done with electronic consistency and precision. Instead, I suggest that you invest in, or borrow, a relatively inexpensive monitor calibration device that will automate and vastly simplify this process. Appendix W contains references to where you can obtain these devices.

3. After you have measured the ways that each TV set differs from the universal standard, you would need to make a series of subtle adjustments to bring them all into compliance with the agreed-upon PCS standard. After this, they would all look the same.

This step in the process is called "profiling" because the monitor calibration device creates a small piece of software that tells the color management system how to compensate for the unique characteristics of your monitor, called a Profile. An ICC profile can be illustrated in the following way:

One way to define "color balance" would be to say that the three primary components of color vision—Red (R), Green (G), and Blue (B)—are all present in equal amounts in mixtures that, when blended together, would appear as "neutral" to your eye. These neutral colors are black, white, and middle gray. Computers translate visible colors into numbers and the values that correspond to the brightness of these colors are 0 for black, 255 for white, and 128 for a value halfway between these extremes.

Neutral middle gray is measured as an equal amount of each of the primary colors and can be diagrammed as shown here:

FIGURE A.1 The digital color numbers of neutral gray.

If it happens that your monitor is lacking the colors red and blue in equal amounts and also some green, this would look to your eye like a darker-than-average gray with a "greenish cast."

FIGURE A.2 The digital color numbers of greenish cast.

To compensate for this imbalance, you would first have to measure it with your calibration device and then create a profile telling you how to compensate for the unique state of this monitor so you could bring it back into neutral balance.

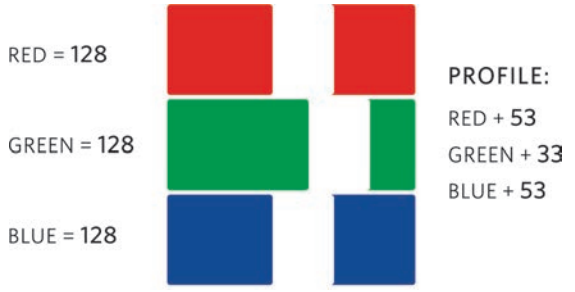


FIGURE A.3 Building a color management profile.

In this case the profile for this monitor would say, "Add Red + 53, Green + 33, and Blue + 53."

After a unique and accurate profile was created and applied to each monitor in the store, they would all look the same.

This illustration greatly simplifies a much more complex process, but it makes the point that the function of a profile is to describe the unique state of an element in your system and provide the specific adjustments needed to make the appropriate corrections.

The profile doesn't actually make the correction itself; that is done by something called the Color Management Module (CMM). With Adobe Photoshop, the CMM is called the Adobe Color Engine (ACE). In the case of this example, the CMM would be the person using the profile information to actually tweak each monitor.

With this example in mind, you can see that **profiles need to be created and applied to every step and every element in the digital imaging process from capturing an image to printing it on a given brand of printer with a particular type of paper and ink set**.

These invisible little pieces of software are working in the background, together with the CMM to keep all your image viewing, creating, and printing tools coordinated and consistent.

This process also allows you to attach profiles to your image files so that if you transfer your photograph to another color-managed system, your images will look just the same as they do on your system. This is called "tagging" in the world of digital photography.

It is worth repeating that every make of printer, every brand of paper, and every set of inks has a unique profile. In some cases, the profiles provided by the manufacturers of printers, papers, and inks will work perfectly with your system if you know how to apply them properly. In other cases, you will have to create custom profiles that compensate for the idiosyncrasies of your system.

After spending days trying to create custom profiles for my system, I learned the wisdom of having it done for me by professionals who offer this as a very inexpensive service. (See Appendix W for a list of references for this service.)

I describe the steps in the process of applying profiles to your monitor and printer under the later section "Color Managing Your System."

Color Spaces

Before we can move on to the practical steps for applying color management to your system, we need to cover one other somewhat abstract concept.

As I mentioned previously, computers interpret visual colors as numbers that they can manipulate to produce the effects we see on monitors and digital prints. To define and visualize the range of colors that different monitors and printers can render, color scientists have devised a system that models these different spectrums of colors as if they existed as three-dimensional rainbows called "color spaces."

Color spaces come in different sizes that depend on what they are designed to represent. For example, the Lab color space is extremely large because it represents all the colors possible for the human eye to see. The sRGB color space is relatively small because it represents only

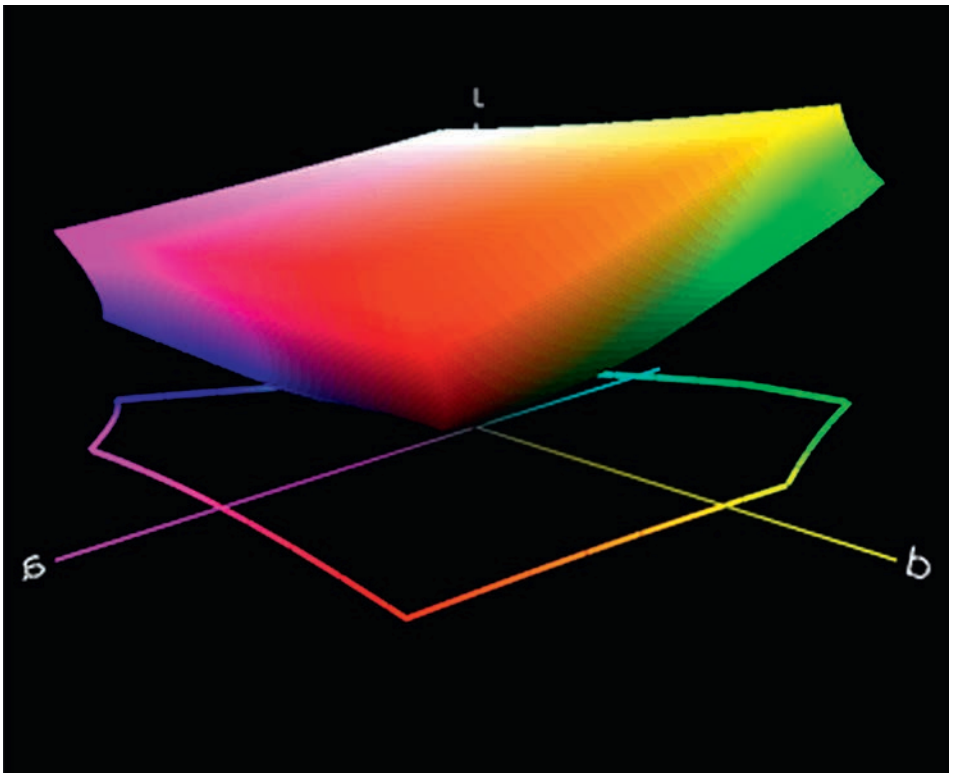


FIGURE A.4 Adobe RGB 1998 color space.

the colors that can be rendered in a typical web browser. There are even color spaces that represent the colors that can be printed on a given paper with a given set of inks.

Understanding color spaces is useful because one key decision digital photographers have to make is the color space they will use as the "working space" for their computer systems. You can think of this as the arena or "gamut" within which all your digital image editing takes place. Any colors that fit inside a given color space are said to be within that space's gamut; any colors that don't fit are said to be "out of gamut."

Problems can arise when there is a mismatch between the color space you have chosen to work in and the color space of the image you are working on. On the one hand, if your working space is too small for the image you're editing, colors that were present in the image will simply be compressed until they fit within the gamut of your working color space. You'll notice this as a loss of subtlety and saturation in your image.

On the other hand, if your working color space is much bigger than the images you're working on, the image's colors will be spread out when you try to edit the image, creating gaps called "color-banding" and "posterization."

For this reason, it makes sense to choose a color space large enough to encompass the colors of your work, but not so large that it creates its own problems.

One nice feature of color spaces is that they can be modeled in three dimensions with software such as Color Think Pro from Chromix and even be combined to see how they compare with each other.

In Figure A.5, the sRGB color space is shown embedded in the Adobe RGB 1998 color space and, as you can see, the Adobe color space (shown as a wireframe) is much larger because, in general, it is designed to account for the colors of images intended for inkjet printers.

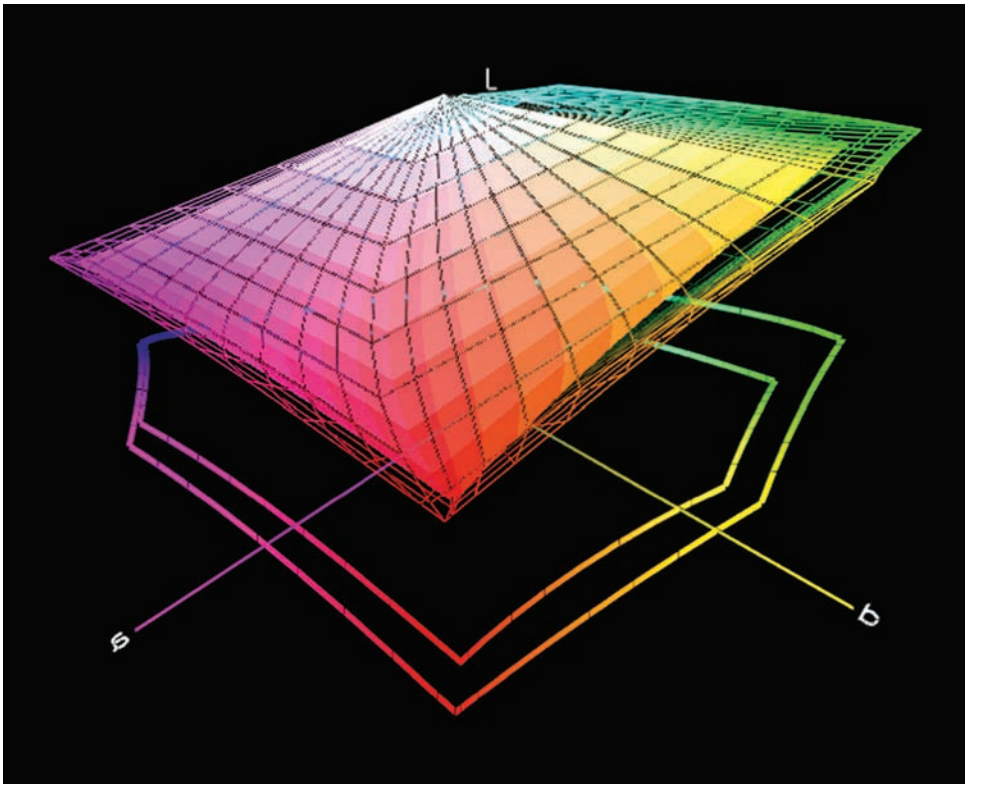


FIGURE A.5 Adobe RGB 1998 and sRGB color spaces compared.

Current, high-quality inkjet printers are designed to print colors that are even beyond the range of Adobe's RGB 1998 color space. Figure A.6 shows a comparison of Adobe's color space and a custom profile I made for my Epson printer.

Notice that although the Adobe color space is generally very large, there are intense yellow colors that are beyond its gamut. If you were to bring an image that had these colors into an Adobe RGB 1998 working space, they would be "clipped," or converted to less saturated numbers.

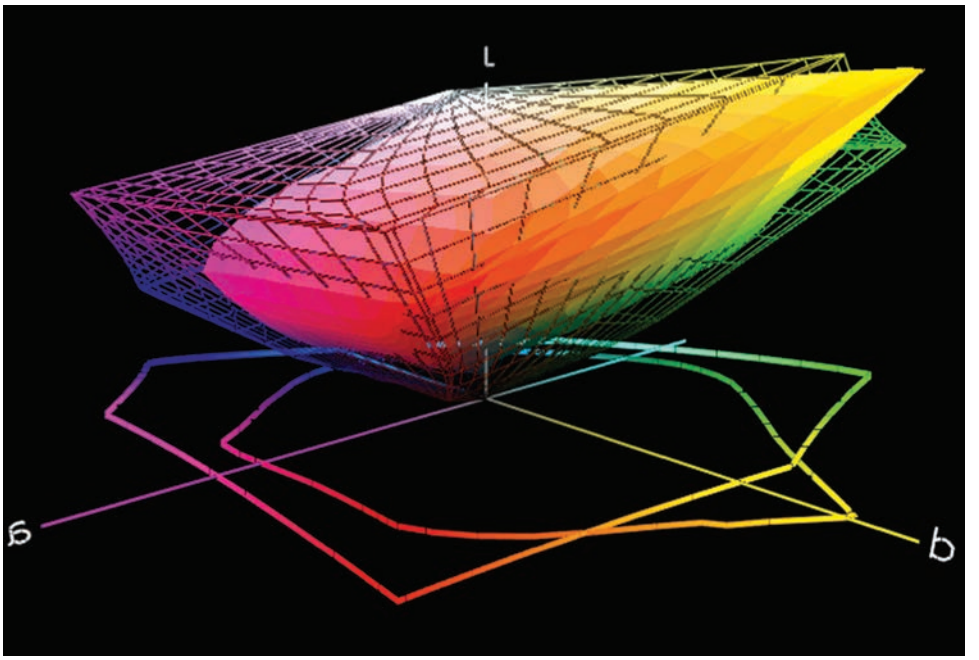


FIGURE A.6 Adobe RGB 1998 color space (wireframe) and a custom profile for Epson Pro4900 Premium Luster paper and ink set.

Digital editing software can be set up to warn you when colors are unprintable or out of gamut.

An alternative would be to use a larger color space like ProPhoto as your standard working color space and then use the Epson profile when you print. The later sections "Choosing Your Color Space" and "Choosing Your Printer Profile" explain how to do this.

After you define a given color space as your working standard, that information is tagged onto every image you edit and save. If you send that file to someone whose computer is set to a different working color space, Photoshop can be set to alert you there is a color space mismatch and offer you choices for conversion. (See Figure A.7.)

Color spaces are known by initials like "CIE LAB" or "LUV," but for digital photographers, the following is what you need to know about the most widely used color spaces:

- **sRGB** is a relatively small color space designed to provide a convenient standard for consumer digital cameras and web designers. In general, sRGB is too small a color space for digital photography intended for fine inkjet prints.
- **Adobe Wide Gamut RGB** is an alternative to the sRGB color space that can contain a wider range of colors but contains colors that are imaginary and cannot be reproduced.
- **ColorMatch RGB** is a standardized monitor color space that is often used as a default when more specific color spaces aren't available. It has a wider gamut than sRGB, but a smaller one than Adobe RGB 1998.

- **ProPhoto RGB** is an extremely wide color space preferred by many digital photographers who work with high-quality images intended for reproduction on photo-quality inkjet printers or recording on photographic film.
- **Adobe RGB 1998** is a wide gamut color space that is currently preferred by most digital photographers making fine inkjet prints.

Color Managing Your System

Applying color management to your system only requires understanding three basic concepts.

First, you need to choose the appropriate color space for the kind of images you plan to create. For the majority of digital photographers this is a very simple decision:

- If you are primarily planning to display your images on the Web, choose sRGB as your working color space.
- If you plan to make fine inkjet prints from your digital files, choose either Adobe RGB 1998 or ProPhoto RGB.

In practice, the difference tends to be that only experts use ProPhoto RGB because its extremely wide gamut requires some skills to manage. Adobe RGB 1998 is generally the safer choice for most photographers.

Second, as stated earlier, in theory all elements of a complete digital imaging system need accurate color profiles, and they need to be applied consistently. This could mean calibrating and creating profiles for everything from your camera, scanner, monitor, printer, and every paper you work with. But in the real world, only a well-calibrated monitor and printer/paper profiles are essential.

Finally, there are three different color managers, and each controls a different part of the overall process. It's important that you understand how to coordinate these three pieces of software so you can avoid conflicts that cause the most common problems:

- Apple's color management software is called **ColorSync**, and in general, it works in the background to make sure that the various color profiles are properly applied.
- Adobe Photoshop uses software called the **Adobe Color Engine** (ACE) that manages the color profiles for your monitor, images, and printers.
- Your printers and scanners use software called **"drivers"** that handle color profiles for each of these devices.

Step 5, titled "Resolving Color Management Conflicts" explains how to coordinate the functions of these different software tools.

[**Step 1**] Calibrate Your Monitor

A precisely calibrated and profiled monitor is absolutely essential for any of the other steps in color management to work properly. There's an understandable tendency to take this step for granted because the images on the screen may look "good," but remember that the key to color

management is creating a coordinated system where all the colors you work with match universal PCS standards. These standards are numerical, so your monitor readouts need to be measured precisely and the resulting profile needs to be stored as the standard for your system.

My strong recommendation is that you use one of the many monitor calibration devices that are available for this task (see Appendix W). The process takes about 10 minutes and requires you to make a few important decisions:

- **White Balance.** This determines the color of white that your eye uses as a point of reference for judging all other colors. I use 6500 k (Medium White) as my standard, but this is purely a personal choice.
- **Gamma.** This sets the contrast ratio that your system uses as a standard. For Macintosh computers, the default is 1.8; and for PCs, it's 2.2.
- **Luminance.** Most calibration devices give you the option of setting the brightness of your monitor to a recommended standard. For LCD monitors, this is 140 lamberts.

Liquid-crystal display (LCD) monitors should be calibrated every 200–300 hours with normal use, but it's a good idea to calibrate them at least once a month just to be sure that the display is correct when you need it.

[**Step 2**] Choosing Your Color Space

The next important step is selecting a color space for your system that sets the parameters within which all your color management operates. This is done in the Color Settings dialog box in Adobe Photoshop.

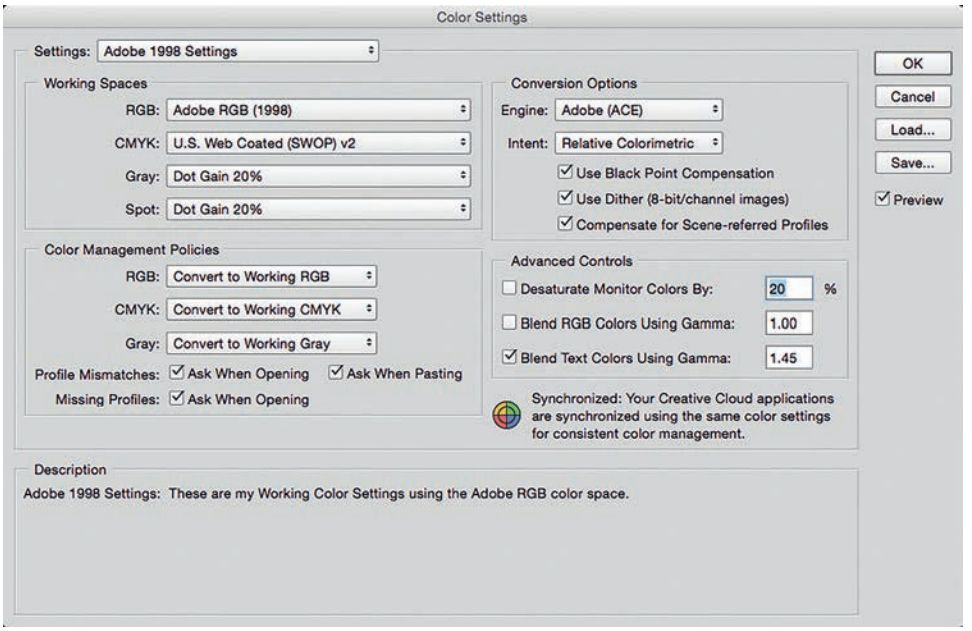

Color Settings
Settings: Adobe 1998 Settings
Working Spaces
RGB: Adobe RGB (1998)
CMYK: U.S. Web Coated (SWOP) v2
Gray: Dot Gain 20%
Spot: Dot Gain 20%
Color Management Policies
RGB: Convert to Working RGB
CMYK: Convert to Working CMYK
Gray: Convert to Working Gray
Profile Mismatches: Ask When Opening Ask When Pasting
Missing Profiles: Ask When Opening
Conversion Options
Engine: Adobe (ACE)
Intent: Relative Colorimetric
Use Black Point Compensation
Use Dither (8-bit/channel images)
Compensate for Scene-referred Profiles
Advanced Controls
Desaturate Monitor Colors By: 20 %
Blend RGB Colors Using Gamma: 1.00
Blend Text Colors Using Gamma: 1.45
Synchronized: Your Creative Cloud applications are synchronized using the same color settings for consistent color management.
OK
Cancel
Load...
Save...
Preview
Description
Adobe 1998 Settings: These are my Working Color Settings using the Adobe RGB color space.

FIGURE A.7 Adobe Photoshop Color Settings dialog box.

The most important choice for this step is found in the "Working Spaces" box. As described previously, if you are planning to create images primarily for the Web, you should choose sRGB as your color space. If you plan to print your images on an inkjet printer, you should choose Adobe RGB 1998 or ProPhoto. All the other Adobe default settings work well for most purposes.

[**Step 3**] Choosing Your Printer Profile

There is probably more confusion about these final two steps than anything else in color management, yet the two issues involved are really very simple:

1. Your computer needs to know what profile to use for the particular printer and paper/ink combination you are using.
2. You have to resolve potential conflicts between Photoshop and your print driver because both have color management functions.

Step 3 asks you to select the profile that will give you the most consistent color match for the specific printer and paper/ink combination with which you are working. To do this, you first have to make that profile available to your system and then enter it in the right place when you make a print.

Remember that a profile compensates for the idiosyncrasies that make every monitor, printer, or paper unique. Different paper surfaces absorb ink colors in slightly different ways, so a print that looks perfect on one paper could look green or magenta on another. To create an accurate printer/paper/ink profile, you first have to make a test print that includes a complete spectrum of colors patches and then compare those renderings to known PCS standards. After this test print has been analyzed with a device called a spectrophotometer, the resulting profile adjusts the printer settings so that the colors match the colors on your calibrated monitor as accurately as possible.

Every manufacturer of inkjet printers distributes a set of profiles designed to work with the inks and papers it recommends. These are usually installed when you install the print driver for your printer, and in most cases, they will work fairly well if you know how to apply them. If you find yourself consistently having to make typical adjustments when you print a given file, this is a sign that your profile is not precisely accurate. But, of course, if you decide to use a paper or ink set that is different from what the canned profile was designed for, your prints may no longer match your monitor. At this point, you will either have to create a new profile on your own for this new printer/paper/ink combination or have it done for you by a professional. As I mentioned, after days of attempting to do this job myself, I learned that the latter choice is far more practical. (See Appendix W for references to reliable and cost-effective custom profilers.)

A typical printer profile will have a name like "MOAB Colorado Gloss Epson 4900." As you can see, this profile is specifically designed for an Epson Stylus Pro 4900 printer using Moab Colorado Gloss paper with Epson inks. If this is the combination you're using, your calibrated monitor and the resulting print will match. Any other profile may give you different results.

Some printer manufacturers install their profiles in folders that aren't easily accessible, but any custom profiles you make should be stored in the following folder on current Macintosh computers: **Home folder > Library > ColorSync > Profiles**.

Assuming that it's installed properly, the following steps will allow you to apply this profile:

1. In Photoshop, when you are ready to print an image, select Print from the File menu. You will now see a large dialog box as in Figure A.8.

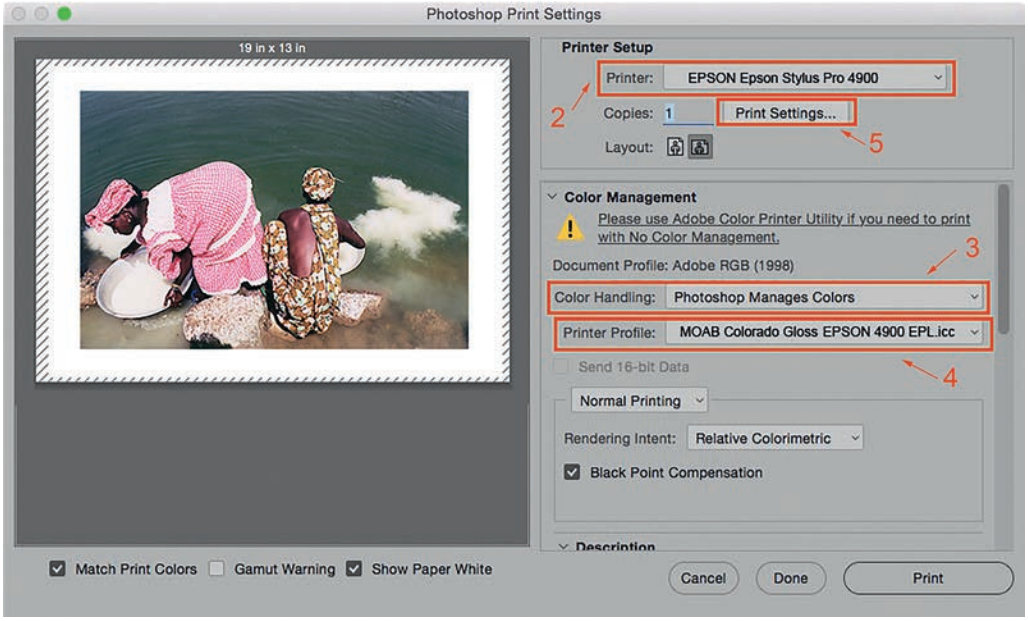


FIGURE A.8 Adobe Photoshop Print dialog box.

2. Use the Printer drop-down menu to choose your inkjet printer.
3. Under Color Management > Color Handling, choose Photoshop Manages Colors from the drop-down menu. This is an important step. For proper color management you do not want both Photoshop and the printer to manage your colors. For this to work properly you should always let Photoshop manage the colors.

[**note**] If by mistake this menu is set to "Printer Manages Colors," you will notice that there is a warning icon and a reminder to enable the printer's color management system when you get to that step.

4. Under Printer Profile, choose the correct specific profile for the printer and paper/ink combination you are planning to use.

[Step 4] Print Driver Settings

At this point, it's important that you tell your computer which print driver it should use and what paper size and print orientation you want.

You do this by clicking the Print Settings button (5) just under the Printer Menu. When you do that, the Adobe Printer Driver box as shown in Figure A.9 will appear.

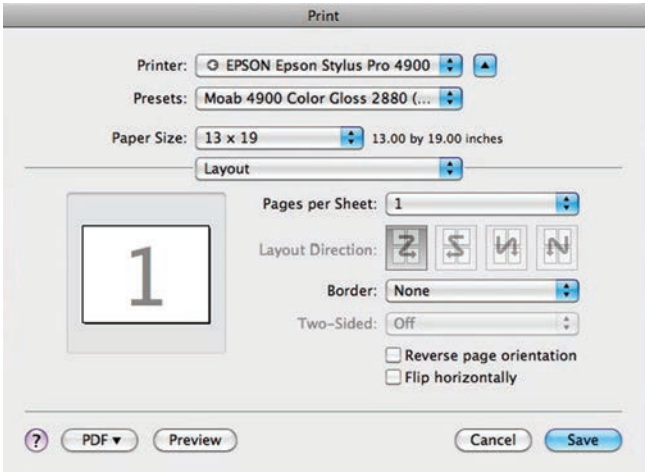


FIGURE A.9 The Adobe Print Driver box.

Make sure that you select the correct print driver from the "Printer" drop-down menu and that your paper size and orientation are correct.

Behind the drop-down menu labeled "Layout" are the all-important Printer Settings choices.

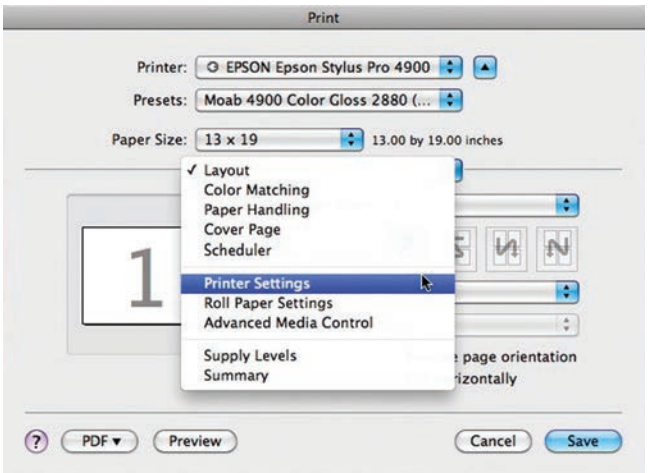


FIGURE A.10 Choosing the Printer Settings box.

Select Printer Settings from the drop-down menu to see the following window.

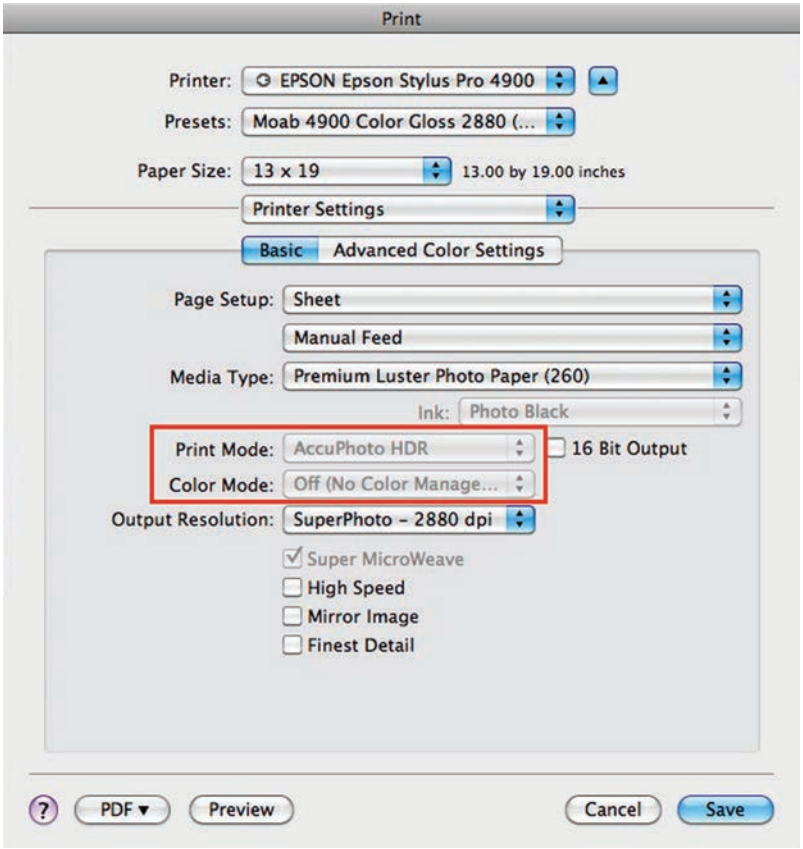


FIGURE A.11 Printer Settings.

[**Step 5**] Resolving Color Management Conflicts

The Print Driver box controls all the specific behaviors of the printer, including the way the printer applies color management if you allow it to.

If the Print Mode and Color Mode menus are grayed out, as illustrated in Figure A.11, your settings are correct and you will not have color management conflicts with the printer driver.

If, however, these choices are lit, change the Printer Settings menu to Color Matching and select the ColorSync radio button to disengage the printer color controls (Figure A.12).

Make sure that the paper profile listed corresponds to the paper, surface, and ink of your choice. If not, go back to the original Print box (refer to Figure A.8) and select it under Printer Profiles.

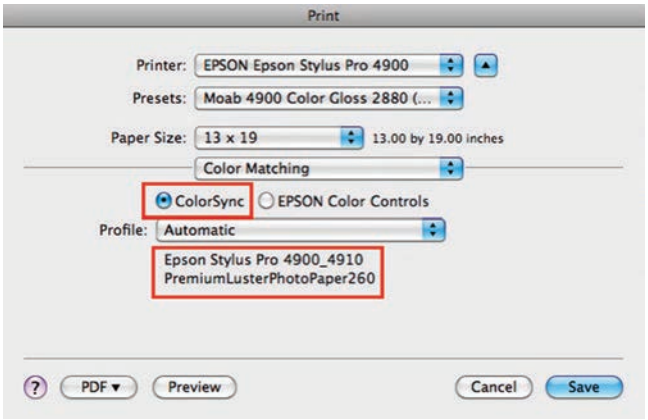


FIGURE A.12 Color Matching box.

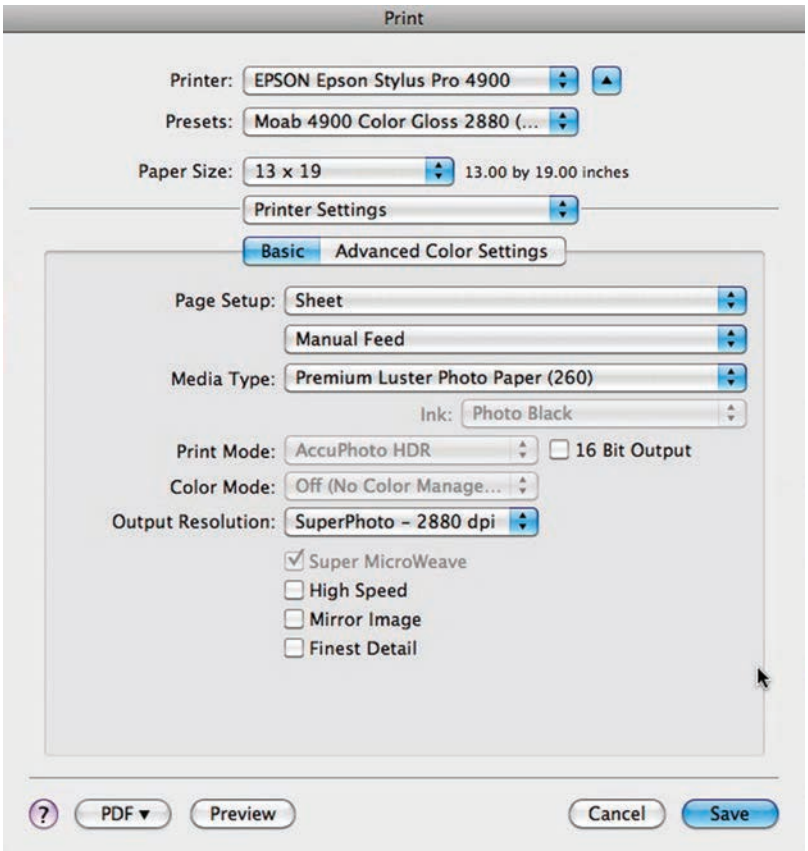


FIGURE A.13 Printer Settings.

The Page Setup menus need to correspond to your choices of paper type (roll or sheet) and handling (Manual Feed or Paper Cassette), and the Media Type must match the surface type of the paper you are using.

Make sure that the settings are as follows:

Printer. The printer you plan to use.
Presets. It's a very smart idea to save presets that contain all the specific settings you customarily work with. This will save you lots of time in the future.
Media Type. This option should be set to a choice that is as close as possible to the specific paper you are planning to print on.
Output Resolution. These settings should be set to either SuperPhoto 1440 or 2880. The latter uses more ink and will give you marginally better quality.

Make sure that the High Speed setting is unchecked.

[**note**] The Super MicroWeave setting is optional. When this is checked the printer will make eight passes rather than the standard four. The result is higher quality but a slower printing process.

At this point, it's a good idea to get into the habit of scrolling down to Summary to double-check that the print driver is set the way you want it to be. Most especially, make sure that the Color Mode setting is still set to "Off (No Color Management)."

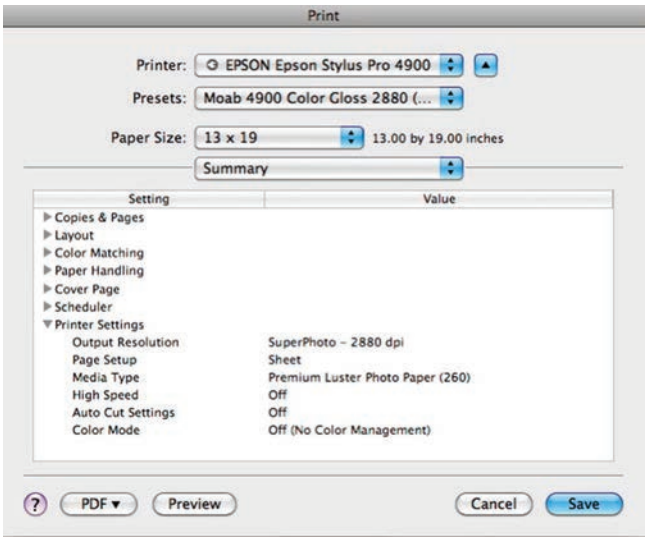


FIGURE A.14 Print Settings Summary window.

It's also a very smart idea to save presets that contain all of the specific settings you customarily work with. This will save you lots of time in the future.

Under the Presets dropdown menu, choose: **"Save Current Settings as Preset."**

Give this Preset a logical name and click OK.

When you click the Save button, you will return to the original print box.

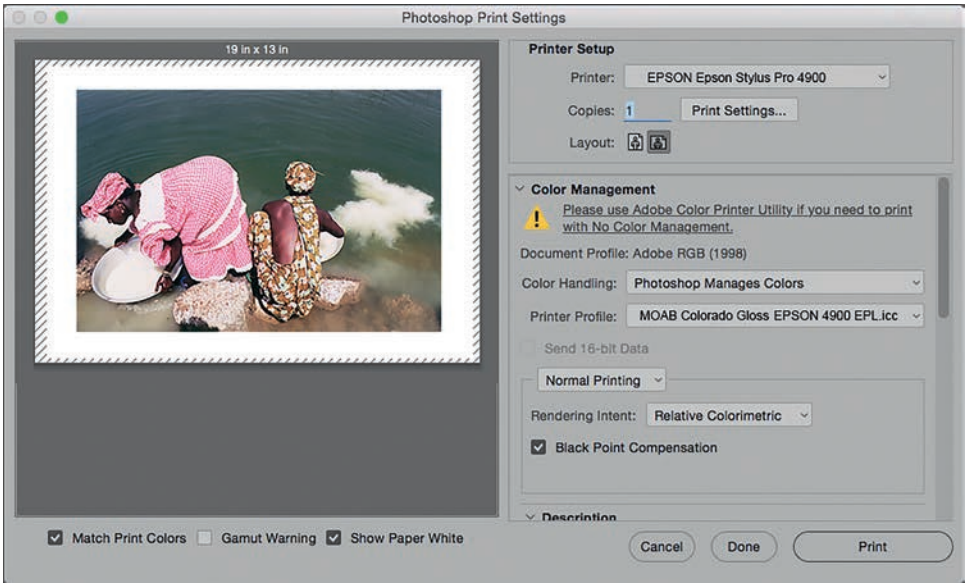


FIGURE A.15 The Final Print window.

When you click the Print button, your printer should now produce a print that very closely matches the image on your monitor.

That's what effective color management is all about.

The RIP Alternative

In a previous edition, I recommended the use of raster image processor (RIP) technology to replace the color management workflow described here. Although these processors are very expensive, at that time I felt they were worth the cost because they provided a higher degree of color rendering and layout options than were possible using Epson's standard choices.

But, since that time, Epson introduced, first the Epson UltraChrome K3 inks, and more recently the Epson Ultrachrome HDR (High Dynamic Range) ink technology—with a new 11-color ink set—which have dramatically improved both the color range and the stability of the prints produced.

Given these remarkable advances, I no longer feel that the RIP alternatives are worth the expense.

Appendix **B**

A Primer on Studio Lighting Photography

Controlling Strobe Brightness in the Studio

Studio strobes provide you with two basic ways to increase or decrease the amount of light illuminating photographic subjects in a studio: You can adjust the distance between the flash head and the subject, or you can increase or decrease the output of the strobe unit within this limits of its capacity. This appendix explains the basics of controlling flash output with strobe power pack adjustments. (See Chapter 11 for a detailed explanation of the effect of distance on exposure in light studios.)

The power packs of modern studio strobe units are capacitors, meaning that they function in the opposite way to batteries. A battery's efficiency depends on its ability to hold energy and dispense it very slowly.

A capacitor is just the opposite. Strobe power packs draw energy from the outlet or batteries they are plugged into and, when they are ready to discharge, the Ready/Test light glows (#1), as shown in Figure B.1.

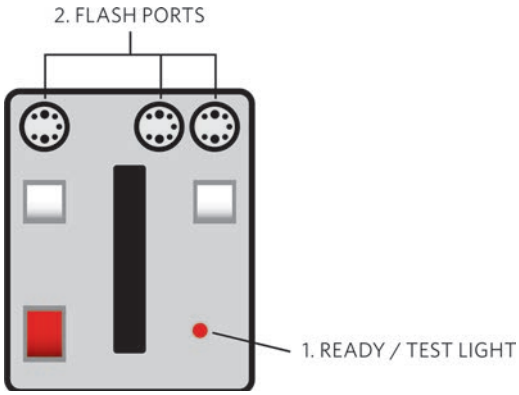


FIGURE B.1 Typical strobe power pack configuration.

In the diagrammed power pack, notice the three ports that allow you to attach three flash heads to this pack (2).

The total amount of energy in the power pack is measured in units known as "watt-seconds" that relate to exposure in a very logical and simple way:

- All power packs provide ways of increasing and decreasing the amount of energy that's distributed to a single head. (See the manual for how the step-down switches are designed for the pack you are using.)
- When the amount of watt-seconds distributed to a single strobe head is doubled, the exposure at a given distance increases by one stop, or one Zone.
- When the amount of watt-seconds is reduced by one-half, the exposure at a given distance decreases by one stop, or one Zone.

The total number of flash heads plugged into a power pack also influences the output of each head attached.

For this example, let's assume that the total capacity of a pack is 2000 watt-seconds and that all this energy is being distributed to the single flash head that is attached to the pack.

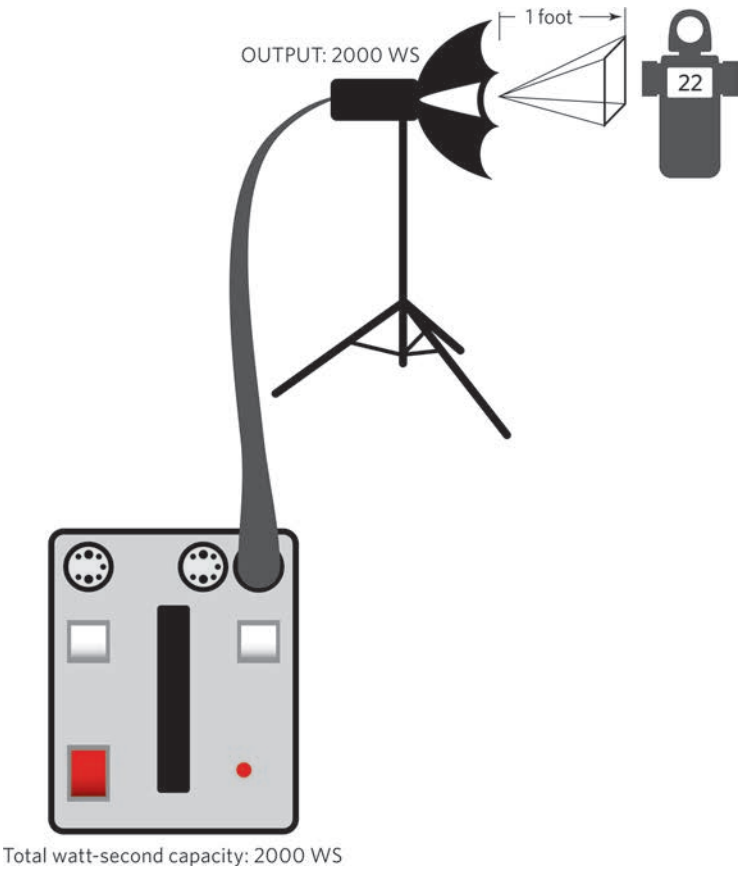


FIGURE B.2 Strobe power pack with one head attached.

The total amount of watt-seconds is always divided by the number of strobe heads plugged into the power pack.

For example, if the total amount of watt-seconds in a given power pack is 2000, with one strobe head plugged in, all 2000 watt-seconds would go to that head, and the exposure might be f/22 at a given distance.

If another head is plugged in to the same power pack, each head would receive 1000 watt-seconds, and the exposure for each head at the same distance would drop to f/16.

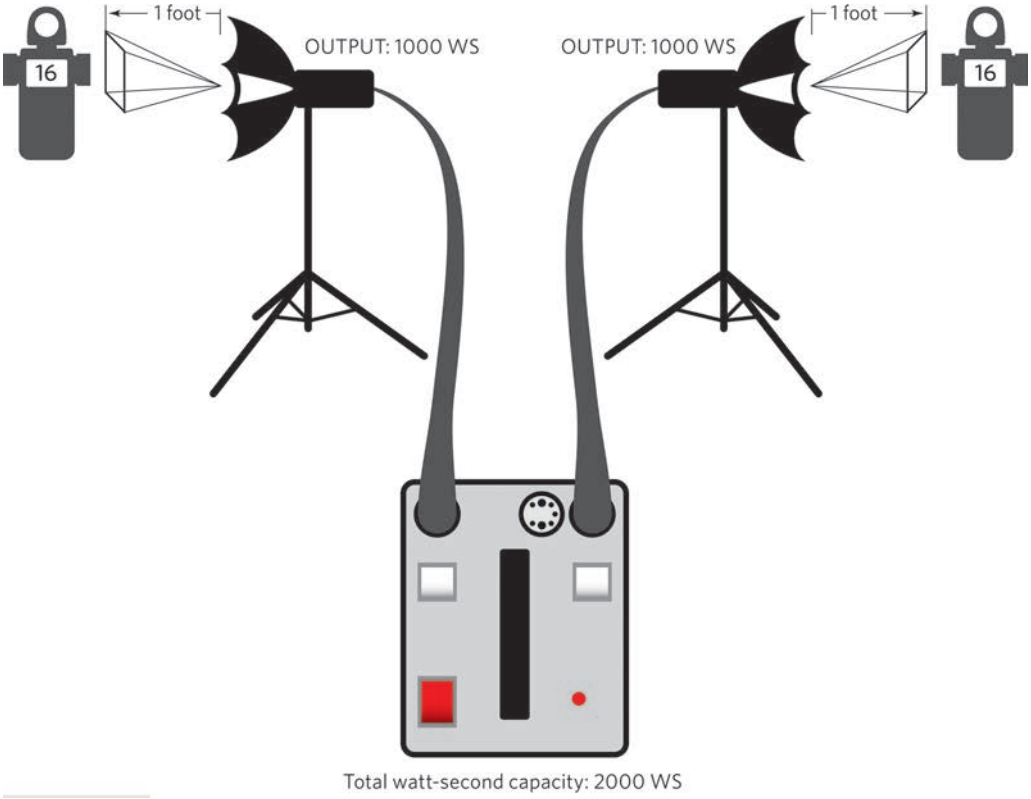


FIGURE B.3 The relationship between watt-second distribution from a power pack and exposure.

As you can see, together with distance, controlling the amount of energy from the power pack is another powerful way to control exposure in a lighting studio.

Another way to think of this is that controlling the amount of energy being distributed to each head is the dramatic way to control exposure in the studio, moving the lights back and forth is the subtle way to effect exposure. Even a small shift in the position of the lights makes a noticeable difference.

[**note**] Consult your power pack's user's manual for detailed instructions on how to achieve different ratios of exposure with that specific unit.

The Visual Qualities of Studio-lit Subjects

It is very easy to take for granted that any object visible in a photograph is simply being rendered as it is. But in fact, the shape and surface textures that we perceive in any photograph can be either enhanced or downplayed based on how it is lit.

OBJECT SHAPE DEPICTION

Hard and Soft Shadows

The shape of an object is made visually clear by the way the attached and cast shadows are either flattened or enhanced based on the direction of the light falling on it.

- Attached shadows are the shadows on the surface of the object.
- Cast shadows are shadows created by light sources of the object that can appear on nearby surfaces.

Cast and attached shadows can be either hard or soft, depending on how abrupt or gradual the gradations or transitions are between areas of lightness and darkness.

The **effective size** of the light source determines the type of shadows produced in the following way:

- **Large** light sources (relative to the subject) produce soft shadows.

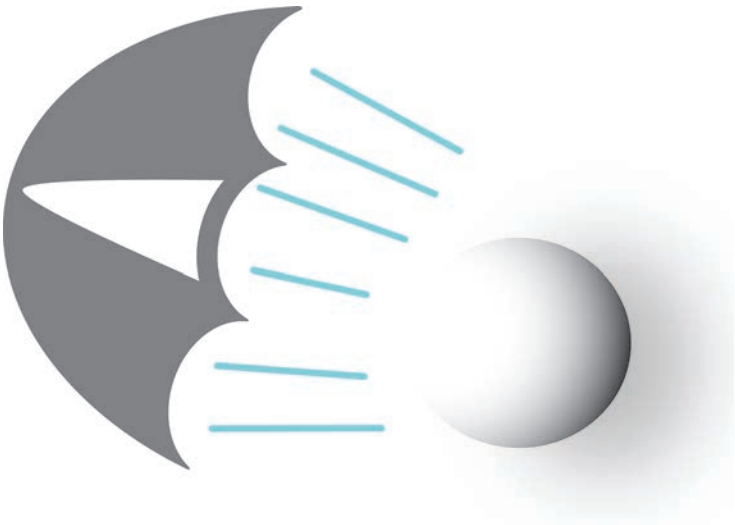


FIGURE B.4 Large light sources produce soft shadows.

- **Small** light sources (relative to the subject) produce hard shadows.

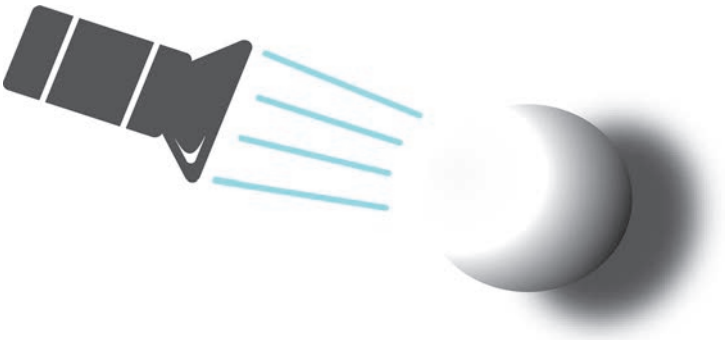


FIGURE B.5 Small light sources produce hard shadows.

Because the distance of the light source from the subject affects its apparent size:

- Large/close light sources produce the softest light.
- Small/distant light sources produce the hardest light.

We intuitively feel that the brightness of the light is the main factor affecting the hardness or softness of the shadows produced. This is not true. The "wrap-around" effect is the determining factor.

Often you need to fill the empty shadows of hard or softly lit subjects in lighting studio setups.

You can use a second strobe head, but you also can create an effective fill light by adding a reflective surface to the set.

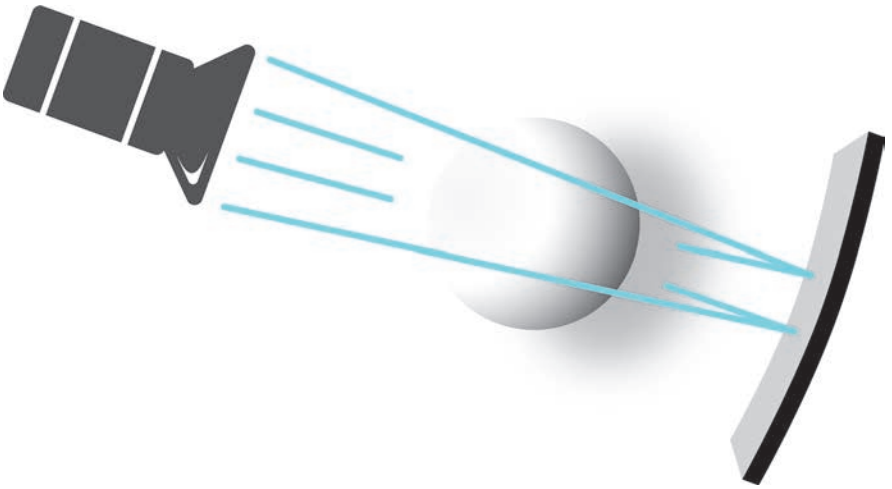


FIGURE B.6 Hard light with a fill reflector.

Reflections and Surface Depiction

Surface reflections provide visual cues to our eyes on whether or not a surface is smooth and highly reflective, or rough and matte textured.

The following three types of reflections determine how a subject looks:

- Diffuse reflections
- Direct reflections
- Glare reflections

1. **Diffuse reflections** are produced by highly textured surfaces.

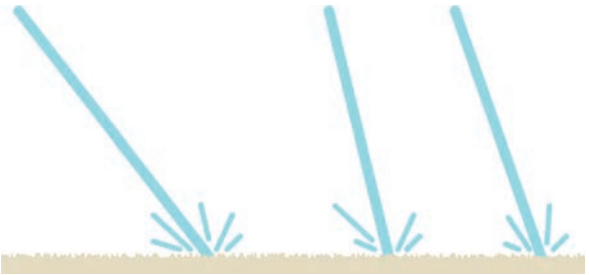


FIGURE B.7 Diffuse reflections.

- Because light scatters randomly from highly textured surfaces, the brightness of a diffuse reflection is not affected by the angle of the light source or the viewing angle.
- The brightness of a diffuse reflection is affected only by the inverse square law (the distance between the light source and the surface).
- White subjects primarily produce diffuse reflections.

2. **Direct reflections** are produced by mirror-like surfaces.

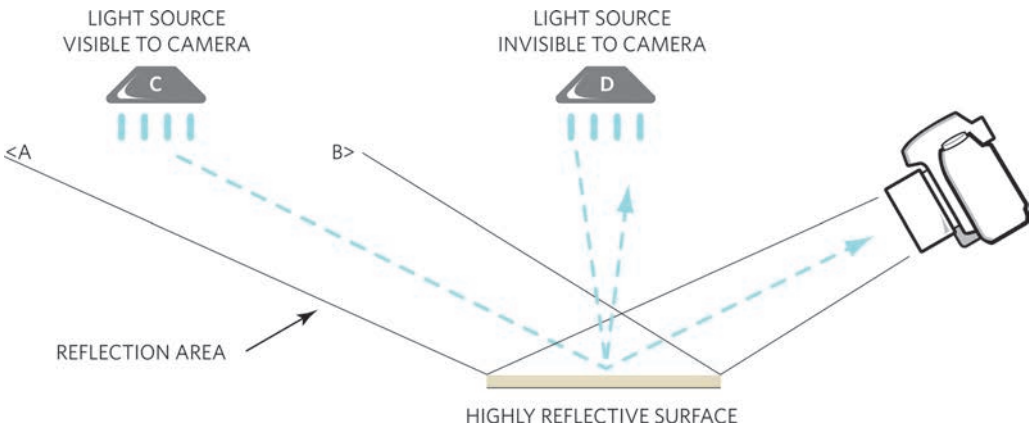


FIGURE B.8 Highly reflective surface with lights in and out of the reflection area.

Direct, or "specular," reflections bounce from mirror-like surfaces at the same angle that they strike them; therefore:

- Any light source *within* the "Reflection Area" (between A and B) defined by the surface will be visible to the camera.
- Any light source *outside* the reflection area (D) will be invisible to the camera.
- The size of the highlight produced by a direct reflection will change as the light source gets bigger or smaller and as the distance between the light and the subject changes; the brightness of the highlight will not.
- Black surfaces show direct reflections more than white surfaces.

To illustrate this effect, Figure B.9 shows a piece of fine handmade jewelry lit by a light source that is positioned outside the pendant's reflections area in part D of the previous figure.

FIGURE B.9 Light positioned outside the pendant's reflection area.

FIGURE B.10 Light positioned inside the pendant's reflection area (*Pendant created by LaShaune Fitch*).

Figure B.10 shows what happens when the light source is positioned inside the pendant's reflection area.

Note that the background of these examples is the same brightness because it is a matte surface, so the light falling on it scatters in all directions and is therefore affected only by the inverse square law.

3. **Glare reflections** behave like direct reflections except that they are polarized.

- Glare reflections are half as bright as direct reflections.
- Glare reflections can be controlled with polarizing filters.
- Glossy, non-mirrored surfaces (polished wood or leather) produce polarized glare at an angle between 40 and 50 degrees.
- Direct reflections can be turned into polarized glare by putting polarizing filters on the light and the camera lens.

ALTERNATIVE EXPOSURES: MOOD DEPICTION

High and Low Key Lighting

The brightness of depicted objects has an effect on the subtle moods they generate in viewers. Normal exposures give the impression of subjects simply being well lit.

FIGURE B.11 Normal exposure.

High key lighting carries a feeling of lightness that is upbeat.

FIGURE B.12 High key exposure.

Low key lighting sets a mood that is more somber.

FIGURE B.13 Low key exposure.

To understand how to translate flash meter readings into alternative depictions of your image, remember the following principles:

1. You must first determine what aperture your image requires for the necessary depth of field. Consider this to be the **key aperture**, and for this example, let's say that it's **f/16**.

FIGURE B.14 Key aperture: f/16.

2. If you adjust the light's position and/or the settings of your power pack so that the meter recommends **f/16**, your image will be rendered to make a well-lit gray card appear as Zone V.

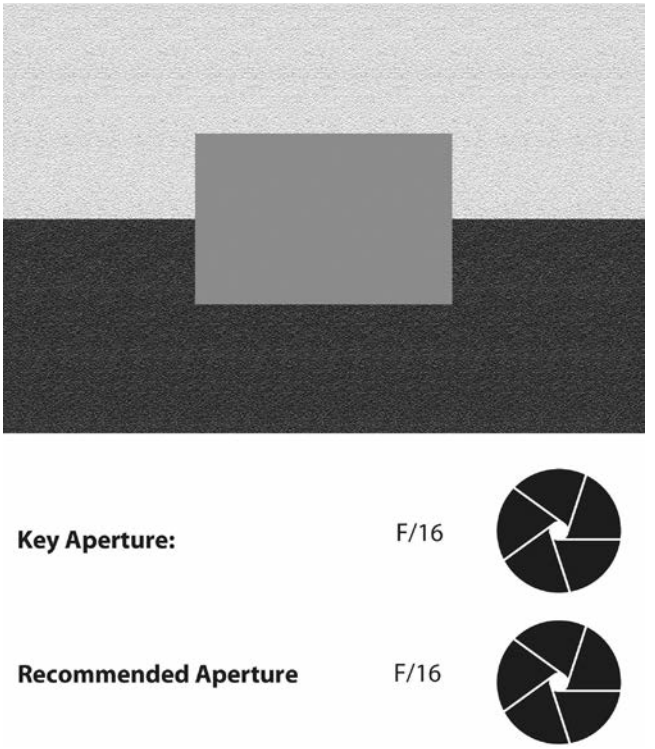


FIGURE B.15 Normal exposure.

3. If you adjust the light's position and/or the settings of your power pack so that the meter recommends one stop **less** than this Zone V reading: *f/11, but your lens is still set to the key aperture f/16, your image will be rendered as Zone IV and will appear low key (darker than normal).*

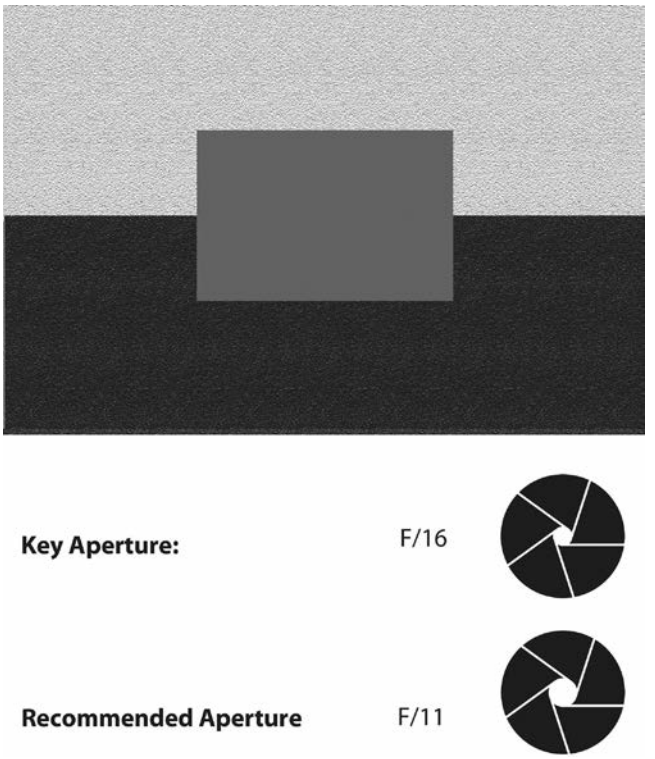


FIGURE B.16 Low key exposure.

4. If you adjust the light's position and/or the settings of your power pack so that the meter recommends one stop **more** than this Zone V reading, say *f/22*, *but your lens is still set to the key aperture f/16*, *your image will be rendered as Zone IV and will appear high key (lighter than normal*).

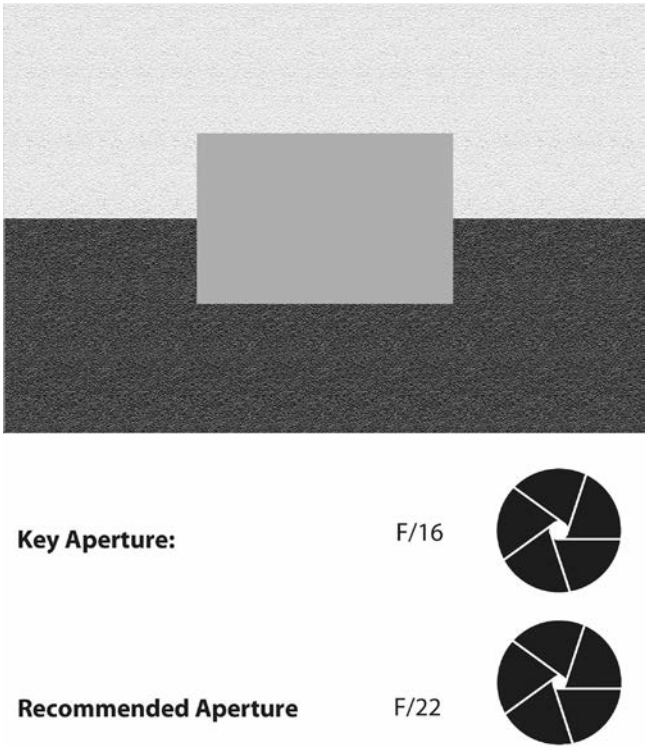


FIGURE B.17 High key exposure.

If this procedure seems confusing, remember that the meter is always trying to render whatever amount of light it sees as Zone V.

This is why when it sees *less* light, it recommends a *larger* aperture (f/11 in this example); and when it sees *more* light, it recommends a *smaller* aperture (f/22 in this example).

Appendix **C**

What Is a Pixel?

Pixel Size

The easiest way to confuse beginning digital photographers would be to ask them with a straight face, "What size is a pixel?"

The reason this is a trick question is that the size of a "pixel" entirely depends on the kind of pixel it happens to be. For example, every person in a football stadium card stunt is essentially a pixel. This is why the definitions of pixels and resolution can be so confusing.

The word "resolution" refers to the number of pixels there are per inch of a given imaging media. In terms of size, pixels come in two different types: fixed hardware pixels and variable image pixels.

Screen Pixels

On the surface of a computer monitor, a pixel is a fixed and rigid physical entity that can never change size. The resolution of monitors is set to values such as 72 or 264 pixels per inch, and that always remains the same.

But keep in mind that these "monitor pixels" are only the tiny dots that create the "image pixels" you see on the screen.

When the screen displays a digital image, these "screen pixels" are used to create image pixels that can be almost any size. For example, when one of these screen pixels is used to reproduce one image pixel, the image display in Photoshop reads 100 percent, or "Actual size." When two screen pixels are used to display one image pixel, the image shrinks to 50 percent.

Digital Image Sensor Pixels

The size of pixels on the surface of a digital image sensor inside a camera is also rigidly fixed.

In a 6-megapixel camera chip, there are just over 6 million pixels on the chips surface, and they can't change size.

Digital chip pixels are organized as shown in Figure C.1.

FIGURE C.1 Digital camera sensor.

These fixed sensor pixels store the visual information that computers use to create digital images.

The amount of information recorded by a 6-megapixel sensor is enough to create an approximately 9″ × 12″ image that prints with 240 dots per inch on an inkjet printer. In terms of digital image quality, this resolution number is the one that means the most.

Scanners

Scanner manufacturers represent the fixed, optical resolution of their products with two numbers: 1200 × 2400 dots per inch (dpi), for example. In this case, 1200 is the number of sensors that are positioned horizontally in the scanner head, and 2400 is the number of steps the carriage motor can take as it travels one inch down the film or document being scanned.

When scanner manufacturers claim that their scanner has a maximum resolution of 9600 dpi, they are describing the amount of information the scanner software can interpolate, or fake.

Digital image pixels that are created by scanners can be many different sizes depending on how many slices, or "samples," the scanner divides the image into. For example, a 300 sample per inch (spi) pixel is 1/300th of an inch wide. A 1 spi pixel is one full inch wide!

Scanners usually refer to the image pixels they create as dots per inch or dpi because, just like camera sensors, the scanner is recording visual information that is intended to be rendered as dots of pigment on the surface of photographs created by an inkjet printer.

One other measure of a scanner's quality is its density range. This number describes the amount of contrast the scanner can record; the higher this number, the greater the scanner's ability to render detail in the shadow and highlight areas. Density range numbers above 3.2 are very good.

Printers

The dots per inch that we see as image pixels in inkjet prints are actually made from extremely small clouds of pigment deposited on the paper by the physical holes in the print head of the printer. For example, there may be 1440 of these tiny holes in the printer head that spread ink on paper to create the image pixels we see in the print.

Appendix **D**

Bit Depth

Computers store information electronically in the form of a number that at the simplest level can either be 0 or 1. This is called one "bit." An 8-bit number in a computer has eight digits and is called a "byte." So, an example of a bit is 0 and a byte is 0000 0000.

Here is how bit depth is notated in digital photography: 8-bit images have a bit depth of 256 levels because if you multiply the number 2 by itself eight times the result is 256 (2, 4, 8, 16, 32, 64, 128, 256).

By this same logic, 12-bit images have a bit depth of 4,096 levels per pixel, and 16-bit images have a bit depth of 65,536 levels per pixel.* Also, in Adobe Photoshop, for technical reasons, 16-bit images have only 32,769 pixel levels instead of the 65,536 you would expect.

The visual information in digital images is organized into channels that hold all the data of either black-and-white tones or gray or each of the three primary colors of red, green, or blue (RGB). It's interesting to consider how many actual colors this translates into. As noted earlier, an 8-bit black-and-white image has only one channel that's called "gray," so there are only 256 tones available.

An 8-bit RGB color image has three channels with 256 pixel levels each, so this adds up to 16,777,216 color possibilities (256 × 256 × 256). You would think that over 16 million colors would be more than enough when you consider that the human eye can perceive only about 17 million different colors. But, as you saw in Chapter 10, pixel colors get lost in the process of editing and the translation from one color space to another. So, to provide leeway to cover this potential loss, scanners can provide 16 bits per channel, which adds up to 281 trillion color numbers!

** Two issues of terminology that can be confusing are that JPEG color images that actually have only 8 bits per channel are sometimes referred to as "24-bit images" because the three separate eight channels add up to 24. These are still only 8-bit images because each channel has only 256 pixels levels.*

One important consideration related to bit depth is that JPEG images are only 8-bit, but if you shoot your images in your camera's raw format, the images will have 12 bits per channel. Because 12-bit image files have 16 times more pixel tonal levels than 8-bit JPEG files, when digital photographers choose the JPEG format for their work, they are essentially wasting thousands of tonal levels that would otherwise be available to work with.

For this reason, unless you are sure that you'll never need to make large or high-quality prints of your image, you should observe the following rule:

Always set your camera to raw (the high bit format) when you shoot.

[**note**] Not all digital cameras offer the option to shoot in raw format. This is a good reason to carefully check the camera's specifications before making a purchase.

One of the practical reasons not to shoot raw would be that JPEG images use less memory on your storage media, so you can capture more images per disk or card.

Also, raw images have to be converted to one of the viewable and editable formats such as .tiff or .psd before you can work with them in Photoshop, and this takes some time and knowledge. Still, the gain in quality is usually well worth the effort of buying a larger storage card and learning how to use the conversion software.

Appendix **E**

Exposure and the Digital Linear Effect

Linear versus Nonlinear

Although the light meters built into digital and film cameras are essentially the same, the way these two processes record and respond to light is different in ways that are important to understand. One simple way to begin looking at this is to consider the graphic systems we use to record the relationship between exposures and print tonalities.

In 1890, the photographic researchers Ferdinand Hurter and Vero Driffield published a seminal paper demonstrating what happened when you plotted exposure and film density on a graph with logarithmic intervals.

If the relationship between light exposure and film density were consistently simple and proportional (or "linear"), the resulting line on the graph would be straight, indicating that, from the darkest value to the brightest, doubling the exposure by stops would produce twice the film and print density.

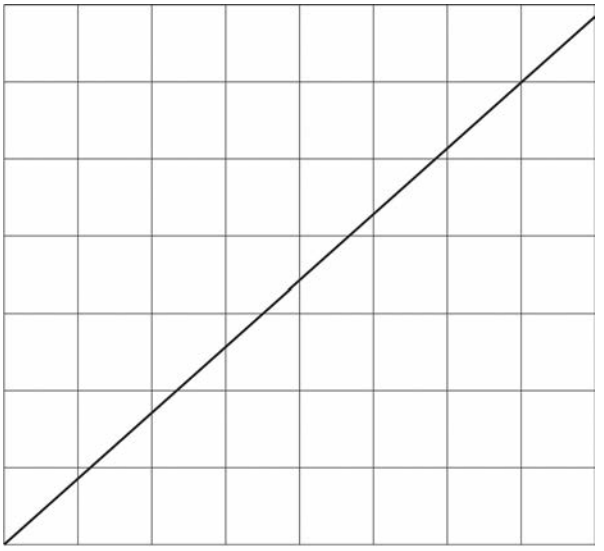


FIGURE E.1 A linear ratio of exposure to negative density.

Instead, what they discovered was that the result was a line with a characteristic curve that was similar for all films and developers.

This curve indicates that equal amounts of exposure don't produce equal amounts of film density throughout the full range of tonal values. At the darkest and brightest ends of the scale, the responses of film to light are compressed, or "nonlinear."

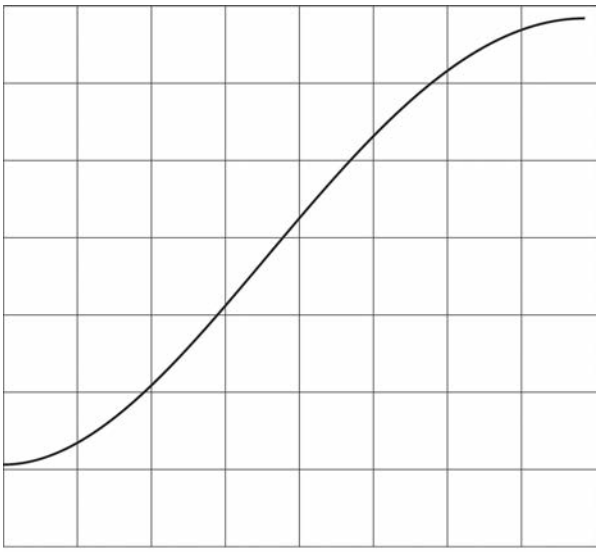


FIGURE E.2 The characteristic curve of exposure to negative density.

Nonlinearity, Zones, and Human Vision

Let's consider how this nonlinearity corresponds to the familiar Zone Scale and, more important, to the ways that we perceive light.

What the characteristic curve shows is that there is less contrast in the darkest and lightest values than there is in the middle tones. This corresponds to the fact that when the light in a room is very dim, it is hard for us to see the difference between various objects on the walls and floors. This is also true if the light is blindingly bright. It is only when a moderate or normal amount of light is available that we can see clear distinctions between different surfaces.

If you look closely at the Zone Scale, you can see this same relationship between the various zones. There is more difference between Zones V and VI than there is between Zones I and II.

FIGURE E.3 The Zone Scale—a nonlinear representation.

The fact that human vision responds to light in a nonlinear way means that we are able to see over a much greater range of brightness levels than would otherwise be true. Some of this nonlinear response is due to the fact that our pupils open wider when it's dark and close down when it's very bright.

But in a deeper sense, the biochemistry of the light-sensitive cells in our retinas also contributes to this effect in ways that are similar to the effects of light on film. This is known as the "adaptation effect" of human vision.

In the Zone Scale representation of nonlinear gradations, there is a natural amount of compression of the tonal values at the high and low ends of the scale, which allows for a very even distribution of the tones on the scale.

This is why the middle gray tonal value (Zone V) falls in the middle of the Zone Scale in a way that feels "natural" to our eyes.

The Digital Linear Effect

The reason this discussion is important is that digital camera chips respond to light in a very simple and straightforward way that has important implications for digital photographers.

We can say that the response of digital chips to light is "linear," and the following example illustrates what this means.

Imagine that Figure E.4 is a digital light sensor that's like a tall glass tube that responds to light by filling up with photons until it reaches its capacity. For this example let's assume that this particular digital sensor is able to record six stops worth of contrast. (The dynamic range of actual sensors can be from approximately 10 stops to 15 stops.) Finally, as we already know, as you decrease exposure, each photographic f/stop lets in one-half the amount of light as the next one.

When photographers shoot in the camera's raw format, the sensor is able to capture 12 bits of visual information. This translates into a total of 4,096 pixel levels.

The question then is: How are these 4,096 levels of tone recorded (or in this example, we could say "collected" in our sensor tube)?

FIGURE E.4 Empty digital sensor.

The brightest light values of your subject, of course, make the strongest impact on your sensor, so they are the ones collected first.

- Because the sensor can record a total of 4,096 levels of tone, that means the first and brightest stop of exposure will fill up with one-half of these, or 2,048 pixel levels.
- The second stop (tonal values that are one stop darker than the first) will fill up with one-half of what remains, or 1,024 pixel levels.
- The third stop fills with one-half of what remains, or 512 pixel levels.

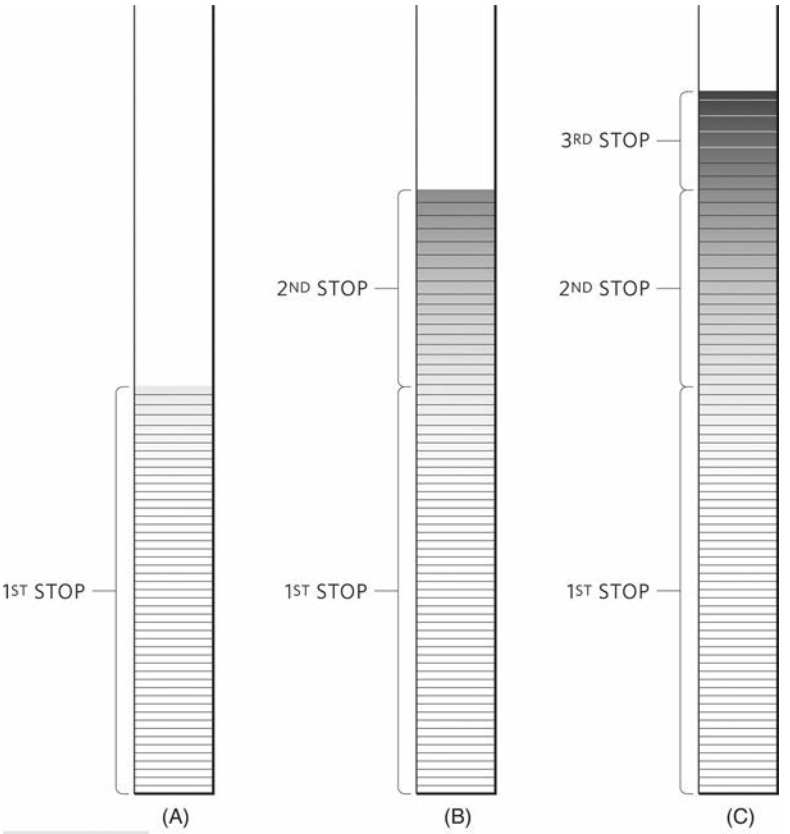


FIGURE E.5 Digital sensors exposed to one, two, and three stops of exposure.

- The fourth stop has 256 levels.
- The fifth stop has 128 levels.
- And finally, the sixth stop, the darkest, shadow values of your subject are left with only 64 levels to record them.

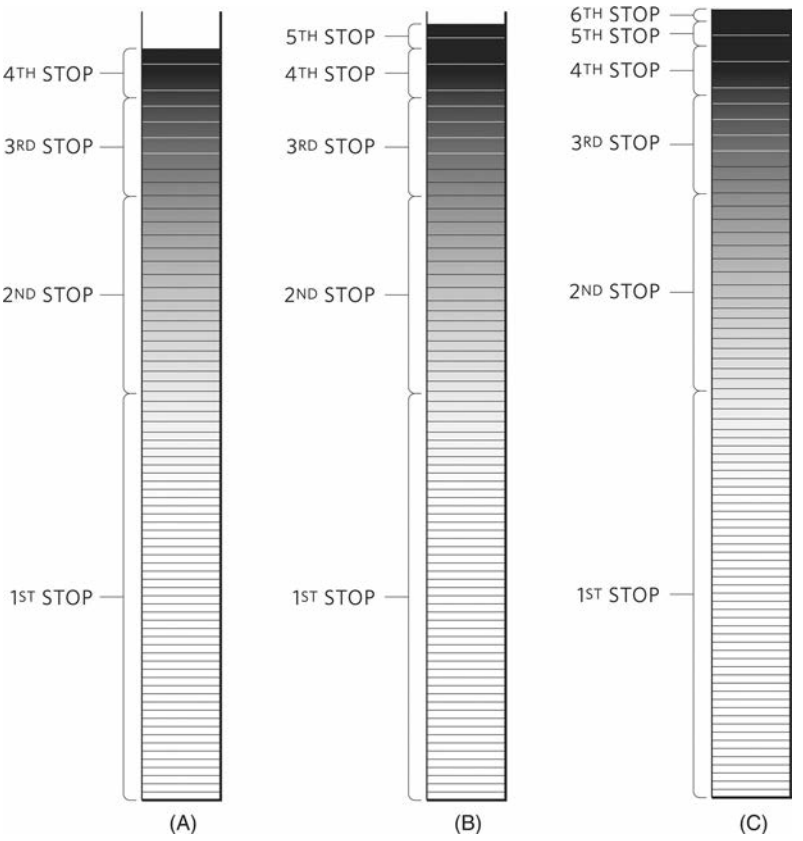


FIGURE E.6 Digital sensors exposed to four, five, and six stops of exposure.

This digital linear effect has two important implications.

First, what we have learned from this exercise is that digital chips have a natural tendency to under represent the shadow values that are so important to the quality of our images.

Because of the digital linear effect, digital cameras don't produce a tonal gradation that looks like Figure E.7 with middle gray in the middle where it feels natural to our eyes.

FIGURE E.7 Tone-mapped, nonlinear gradation.

Instead, digital cameras produce a gradation like Figure E.8 where most of the scale is devoted to the lightest tonal values and very little is left for the darkest tones.

Notice the similarity between Figure E.8 and example C in Figure E.6.

FIGURE E.8 Camera Raw linear gradation.

The difference between these two ways of measuring and rendering light values has one other extremely important implication. In Chapter 10 under "The Quality of Digital Images," we learned that the more pixel levels a digital image devotes to rendering a tonal gradation, the more smooth, detailed, and photorealistic that gradation will be. Because of the digital linear effect, the number of pixel levels that digital cameras assign to the light, middle, and dark values of the spectrum aren't equal!

An equal distribution of levels across a "normal" nonlinear gradient would look like Figure E.9.

FIGURE E.9 Pixel levels of a tone-mapped, nonlinear gradation.

In this example, the highlight, middle, and shadow values each have an equal number of pixel levels defining them.

Instead, digital camera sensors distribute pixel levels across the linear spectrum in a way that can be diagrammed as shown in Figure E.10.

FIGURE E.10 Pixel levels of a Camera Raw linear gradation.

Notice that the highlights have many more pixel levels defining them than do the middle or shadow values. This again is like Figure E.6C turned on its side.

One important function of raw conversion software is to remap the linear tonal gradation produced by digital camera to a gradation of tones that look more natural to our eyes. This is called "tone mapping." This is a function that has dramatic implications for the way we should expose and process digital images.

The fact that so few levels of tone are devoted to the shadows explains why banding and posterization are such a problem when the contrast of underexposed digital images is expanded (refer to Figure 10.28).

If you properly expose digital images as explained in the section "The Zone System of Digital Exposure" on page 155, then your shadows will fall on exposure stops as near to the middle of the scale as is possible given the dynamic range of the image you're shooting. This way, the images will be recorded with more levels for you to work with when you edit the images in Photoshop.

Appendix **F**

Digital Light Meters and the Zone System

As you saw in the preceding chapters, analog spot meters are ideally suited for applying Zone System methods to the problems of calculating accurate exposures and determining the contrast of photographic subjects for development recommendations.

What makes the dials of these meters so useful is that they are designed to display a wide range of the EV numbers when you make a light reading so that it becomes very easy to visualize the relationships between these numbers and the exposures they correspond to. As explained in Chapter 7, it is even possible to attach Zone Scale decals to the meter dials so that you can see both the placements and the fallings of Zones in your scene at a glance.

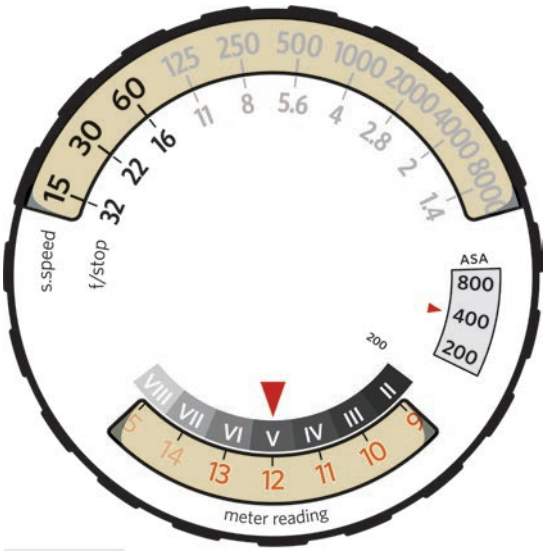


FIGURE F.1 Analog meter dial with Zone placements.

Figure F.1 illustrates an analog meter dial, and as you can see, when EV 10 is placed on Zone III, EV 12 falls on Zone V, EV 13 falls on Zone VI, and so on. Also note that the equivalent exposures are also easy to see.

Figure F.2 shows the same readings with a digital meter and, although the exposure is the same (f/22 at 1/30), the placements are not visible.

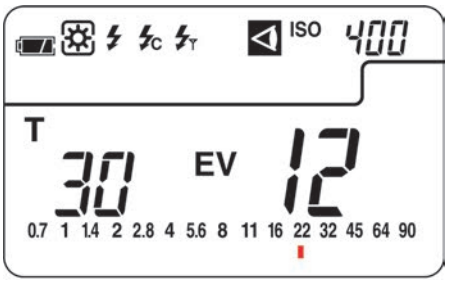


FIGURE F.2 Digital meter dial.

And yet, as handy as these meters and dials are, there are a number of reasons why learning how to use digital light meters for the Zone System practices makes a lot of sense.

For one thing, analog meters like the classic Pentax Spotmeter V are no longer readily available. Photographers these days are much more likely to have multipurpose digital meters like the ones made by Sekonic and Gossen, among others.

Another major advantage of digital meters is their versatility. Meters like the Sekonic Digitalmaster L-758DR function as both spot and incident, ambient and flash meters, and they come with many useful features that are designed to address a wide range of different photographic applications.

This extreme versatility also tends to make these meters complicated to master, so a good approach would be to carefully understand how you need the meter to function in specific situations and then ignore all of the other various features that are not necessary for your work.

To illustrate this point, I would like to illustrate how one specific and popular professional meter applies to the kinds of Zone System–related problems we have been learning.

The meter I'll use is the previously mentioned Sekonic Digitalmaster L-758DR. If you own this meter, please refer to the owner's manual for detailed instructions on how to perform some of these functions. If you follow along with this example, you will see that most digital light meters can be made to work in ways similar to these examples.

Digital Light Meter Settings

The first challenge owners of digital spot meters may have is setting them up so that they display EV numbers. As we have seen, using EV numbers to read reflected subject areas makes the process of measuring contrast very easy. Unfortunately, by default, many brands of digital

meters display only f/stop reading and shutter speeds unless you do something special to make EV readings visible.

For example, with the Sekonic L-758DR, the "EV Mode" is listed in the user's manual as "Custom setting no.5 and Item no.1." This means that you have to carefully follow the manual's instructions to activate the Custom setting mode and then choose the numbers just listed.

With older models of Sekonic meters, if you remove the battery cover, you will see a row of tiny white dual in-line package (DIP) switches that allow you to turn on the EV mode. (Consult your meter's manual for detailed instructions for how to do this.)

Here are illustrations of how your meter will look before and after changing it from its default state to EV Mode.

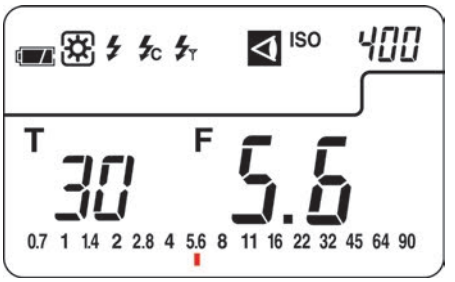


FIGURE F.3 Digital meter dial in Default mode.

Then it will turn into a display that looks like the following figure.

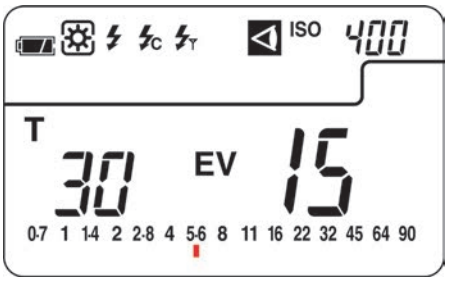


FIGURE F.4 Digital meter dial in EV mode.

Note that in this mode you can see both the EV reading of the metered area and the recommended exposure with the aperture indicated by the marker.

The Zone System and Digital Meters

In the preceding chapters, we learned that there are four key steps to working with the Zone System to create properly exposed and developed negatives:

1. Previsualizing.
2. Placing your Important Shadow on the proper Zone.
3. Measuring the contrast of your subject using Zones.
4. Determining the correct exposure.

The following sections show how you use a digital spot meter to perform these steps.

Previsualization, Placement, and Contrast Measurement

Imagine that Figure F.5 is a subject you are planning to photograph. The figure shows a reasonable way to previsualize this photograph.

FIGURE F.5 Zone Placements.

With your digital spot meter set to EV mode, you could easily take meter readings of all these key areas and enter them on a simple Zone Scale form like the one illustrated here.

[**note**] Digital meters offer alternative ways of comparing shadow and highlight readings. For example, with the Sekonic meter we're using for this demonstration, you can meter shadow and highlight areas and use the Memory function to place markers on the f/stop numbers that correspond to each. The idea is that with these readings displayed on the dial, you could either count the number of stops between these two or use the Average Button to display an exposure between these two. This would give you an exposure that might be approximately correct, but the Zone System method is much more precise and flexible.

As you can see, charted in this way, the range of contrast of this subject is clear and, because the Important Highlight is falling on the proper Zone, this negative would require Normal Development. (See Chapter 6 for a more detailed explanation of this process.)

Exposure Determination

We learned in Chapter 5 that the first step in the process of determining the correct exposure would be to carefully meter the area you previsualize as Zone III in your subject.

Your meter would look like Figure F.6 after making this reading.

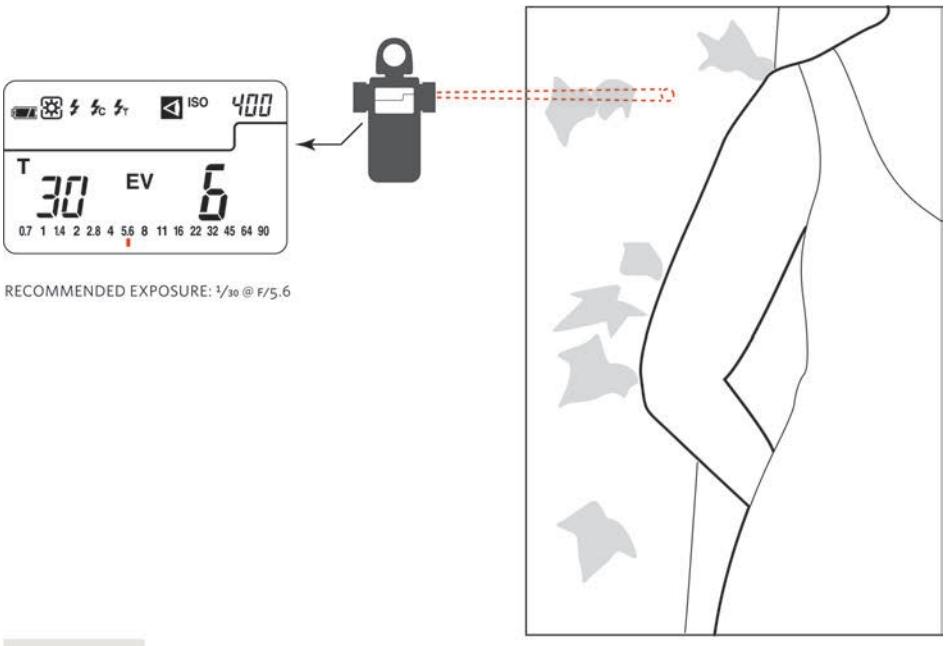


FIGURE F.6 Zone V exposure recommendation (1/30th @ f/5.6) for area previsualized as Zone III.

When you keep in mind that, at this point in the process, your meter is recommending a Zone V placement for this Important Shadow area, your next step would be to simply make note of the meter's recommended Zone V exposure for this area and stop down to the proper exposure of **1/30 at f/11** and then take the picture.

Although this method will work, the disadvantage is that it would require you to remember to make the necessary two-stop adjustment, and it is not obvious what the equivalent exposures to the proper placement would be if you needed either a different shutter speed or f/stop.

Using the Sekonic Digitalmaster L-758DR meter as an example, the following procedure shows a slightly more complicated but functional way to do this:

1. Make sure that the meter's EV reading for the Zone III area is visible on the meter's dial.

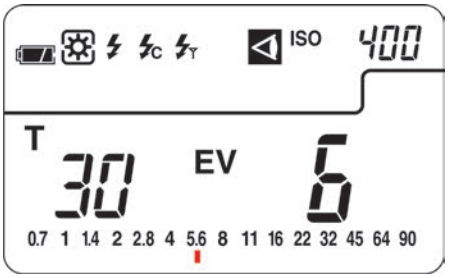
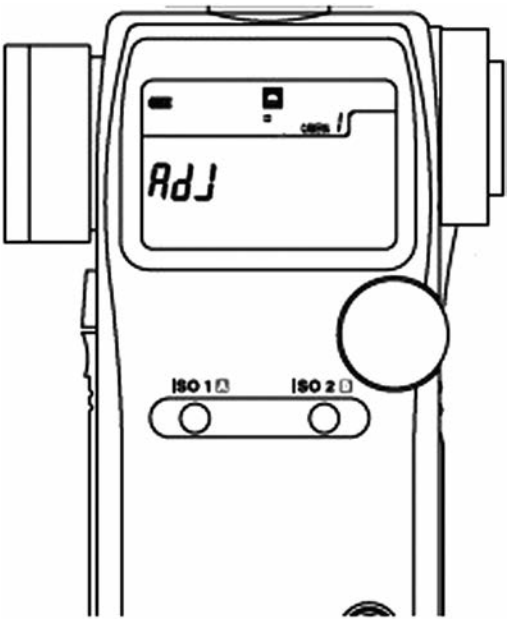
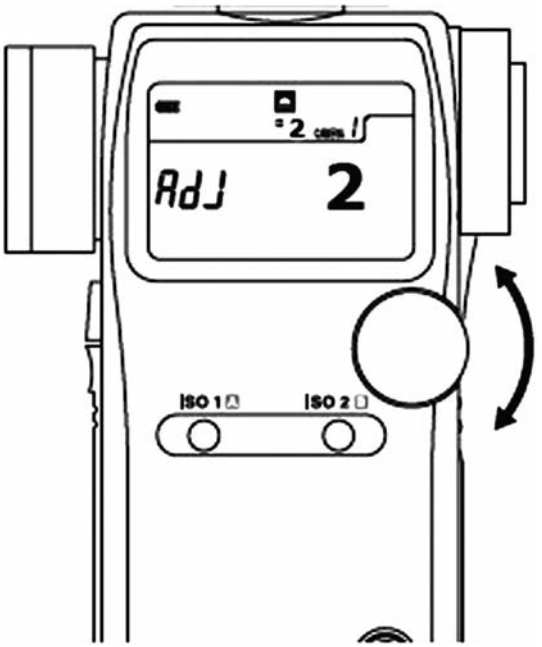


FIGURE F.7 Zone V exposure recommendation (1/30th @ f/5.6) for area previsualized as Zone III.

2. Enter the meter's Exposure Compensation Mode by holding down **both** the ISO1 and ISO2 buttons at the same time. Note that you'll probably have to lay the meter on a table to do this effectively. This is the way the meter's dial will look:



3. Turn the meter's jog wheel until you see the number +2 in the window. This indicates that you are making a two-stop adjustment to the meter's Zone V recommended exposure.



4. As soon as you let go of the two ISO buttons, the meter will revert to the EV mode and you will notice that the meter's EV reading is two EV numbers higher and that the recommended exposure is two stops darker.

   This is the correct Zone III placement of your original meter reading of the area previsualized as your Important Shadow area.

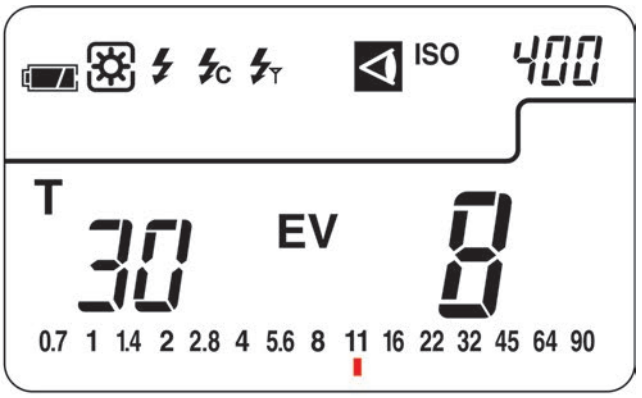


FIGURE F.8 Zone III exposure recommendation (1/30th @ f/11) for area previsualized as Zone III.

As discussed in Chapter 5, the logic of what the meter is now displaying is as follows: If EV number 6 is placed on Zone III, then EV number 8 falls on Zone V.

If the meter's Zone V placement of EV 6 was **1/30th at f/5.6**, then the corrected Zone III placement of that reading would be two stops less exposure, or **1/30th at f/11**.

If this is not clear, review Chapter 5.

The key advantage of using this method is that, when the meter is displaying the correct Zone III placement, you can use the meter's jog wheel to change the recommended exposure to any of its equivalents and be sure that all of them are correct.

One very important point to note is that, with this exposure compensation adjustment programmed into your meter, it will **always** automatically place a reading it makes **two stops darker** than it normally would. What you would now have is a Zone III placing digital light meter. This could make the process of determining Zone III placements very easy, but you would always have to remember only to take meter readings of areas you previsualize as Zone III. If you were to forget and try to use this meter in a normal way, your exposures would be consistently underexposed. For this reason, it might be a better idea to set it back to Exposure Compensation 0 after each time you use the meter.

Appendix **G**

A Primer on Basic Film Photography

This appendix is designed for students who need a brief review of basic photography to better understand some of the terms and concepts used throughout this book. In general, this appendix provides a summary of those principles and techniques that relate to film exposure and development. Because the primer is intended to serve only as an aid to learning the Zone System, many important subjects aren't covered in detail. For a more comprehensive text on basic photography, I recommend the following books:

- *Black and White Photography: A Basic Manual*, (3rd ed.) unabridged
  Henry Horenstein
  Little, Brown and Company
- *The Ansel Adams Photography Series*, (10th ed.)
  Ansel Adams
  Little, Brown and Company
- *Photography*
  Barbara London, Jim Stone, and John Upton
  Prentice Hall

Unfortunately, photography is notorious for being complicated and difficult to learn. In the beginning, it is easy to get lost in the maze of photography's many inverse relationships. At every step, it seems as if something light is turning something dark, which in turn causes something else to become light again. Confusion is understandable, but photographic processes are easier to comprehend if you keep in mind that you'll have to deal with a limited number of very simple materials that consistently perform very simple functions.

Photographic Emulsions

The essential component of photography is a light-sensitive coating called an **emulsion**. When this emulsion is spread on one side of a piece of transparent material, we call it **film**. When an emulsion is applied to a piece of paper, it is used to make **photographic prints**. Film and prints may appear to be very different, but their emulsions are essentially the same.

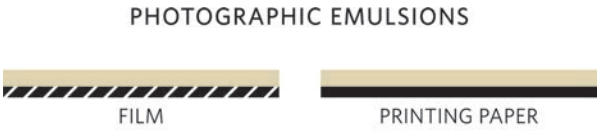


FIGURE G.1 Film and paper emulsions.

All photographic emulsions respond to light in a simple way: Wherever the emulsion is exposed to light, a fine layer of metallic silver will be formed after development. The greater the amount of exposure, the more dense the deposit of silver will be.

The Negative

On the film, these densities of silver are seen as the shadow-like reversed images we call the **negative**. The negative image is tonally reversed because any area of the scene that is bright will produce a dark layer of silver on the film. Conversely, a darker area of the scene will result in a relatively thin or transparent area on the film. See the left side of Figure G.2.

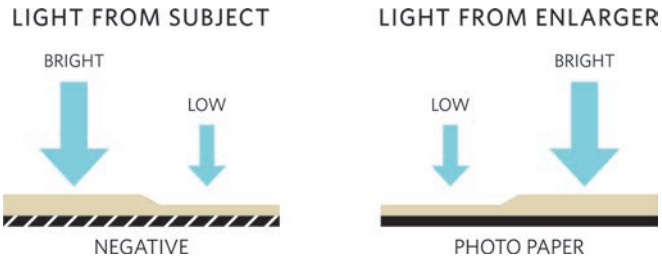


FIGURE G.2 Film and paper densities.

The Print

The photographic printing process reverses the light-to-dark effect of the negative. The enlarger projects the shadow of the negative onto the emulsion of the paper. Once again, the light that passes through the transparent parts of the negative (corresponding to the darker parts of the subject) produce dark layers of silver on the white paper after development. The more transparent a given area of the negative, the more light it will transmit to expose the paper and the darker that area of the print will become. The areas of the negative that

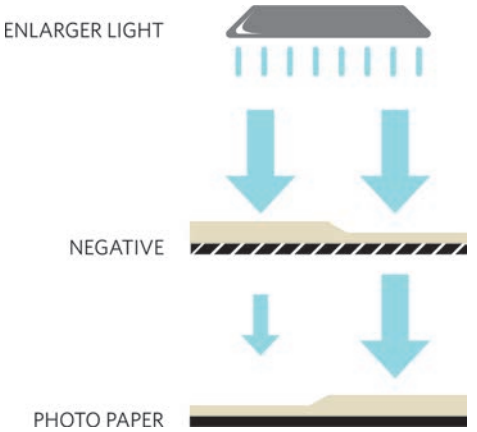


FIGURE G.3 Enlarger, negative, and print.

are more dense (corresponding to the lighter areas of the scene) block more light. As a result, those areas of the print remain light. In this way, the lifelike image of the print will be produced.

The overall tonality of a print can be made lighter or darker by increasing or decreasing the amount of light that exposes the paper. Selected areas of the print can be darkened by adding more light to those areas. This is called **burning in**. If you want to make a certain part of the print lighter, all you have to do is hold back the light in that area with your hand or a tool. This is called **dodging**.

To distinguish between the light and dark areas of the subject and the light and dark areas of the print, subject brightnesses are called **subject values**. The gray, black, and white areas of the print are called **print values**, or **tones**.

Let's summarize what we have learned about emulsions, negatives, and prints:

1. The photographic emulsions of the films and prints are essentially the same. When an emulsion is exposed to light, it produces a density of silver after being developed. The greater the exposure, the greater the density.
2. A light value in the subject produces a high density in the negative, which results in a light tone in the print.
3. A dark value in the subject produces a low density in the negative, which results in a dark tone in the print.

Memorize these three principles before you go on.

Processing

After a photographic emulsion has been exposed, it must be processed for the image to appear and remain stable. Processing means putting the emulsion through a series of chemical baths called developer, stop bath, and fixer. The chemistry and procedures are essentially the same for processing film and paper. The main difference is that film processing must be done in complete

darkness to prevent the film from becoming fogged. Print processing can be done under a red-filtered light called a **safelight**. You should read the instructions supplied with all chemicals before using them.

[**Step 1**] Developer

Before an exposed emulsion has been processed, there is no noticeable change in its appearance. At this point, the negative is said to contain a "latent image." The developer chemically converts this latent image to the visible silver image that makes up the negative and print. Remember that **the longer the emulsion is left in the developer, the more dense these deposits of silver will be**. If film is left in the developer for too long, these deposits of silver will become so dense that they will block too much of the light from the enlarger, and the print will be too white and contrasty. This effect is called overdevelopment. If a negative is underdeveloped, areas of the print that should be white will instead be gray, and the print will be dark and muddy. Prints that are under- or overdeveloped will either be too light or too dark, respectively. For this reason, the development stage of the process must be timed carefully. As you will learn from this book, the correct development time for film depends on the contrast of the subject. The standard development time for most photographic paper is from 2 to 4 minutes. (For more information on developers, refer to Appendixes M, N, and O.)

[**Step 2**] Stop Bath

Because the timing of the development stage of the process is so critical, it is important that the emulsion stops developing as soon as the proper density has been reached. Developers must be alkaline to work. Because stop baths are acidic, immersing films or papers in a stop-bath solution will stop the developing process immediately. A 15- to 30-second rinse in fresh stop bath is sufficient.

[**Step 3**] Fixer (Hypo)

The fixing bath dissolves the remaining unexposed silver in the emulsion and allows it to be washed away. It is important that the fixing stage of the process be complete because any residues of unexposed silver will eventually stain the film or print and ruin the image. If your fixer is fresh and properly diluted, the minimum time that you should fix your negatives and prints before turning on the white light is 2 minutes for negatives and 1 minute for prints. Certain rapid fixers reduce the time required for complete fixing. Be sure that you read the manufacturer's instructions very carefully for proper dilutions and times.

[**Step 4**] Washing

After your negatives or prints have been processed, they must be thoroughly washed in clean water to remove any traces of fixer from the emulsion. The use of a hypo-clearing agent will greatly reduce the amount of washing time necessary to do a good job. Once again, carefully follow the manufacturer's instructions. Improperly washed negatives and prints will become stained.

[**Step 5**] Drying

Many photographers take drying for granted, but it's easy to ruin a good negative or print at this point. A wet emulsion is very soft and can be scratched or attract dust if you aren't careful.

Even more serious are the uneven densities that can form in negatives because of drops of water drying on the surface of your film. To avoid this, you should always use a wetting agent in your final rinse to prevent spotting. This isn't necessary when drying prints. Be sure to dry your negatives and prints in a clean, dust-free area.

Efficient processing is essential for getting good results in your photography. There is nothing more frustrating than spoiling a good negative by being sloppy or careless. Particular attention should be paid to the following points:

1. **Cleanliness.** Many unnecessary negative and print defects are caused by not washing your hands, tanks, trays, and reels carefully. Traces of fixer or developer on your fingers can easily leave stains on your prints that can't be removed. Keep in mind that even a soiled towel or a contaminated light switch can transfer chemicals to your hands if you aren't careful. The first time you discover a thumbprint etched into your favorite negative, you will appreciate the importance of being careful and clean.

2. **Agitation.** Agitation means causing your photo-chemistry to circulate and flow around the film or paper by keeping the development tank or printing tray in motion for a given amount of time during each stage of the process. This is necessary for the development and fixing of the emulsion to be even and complete. Film agitation is usually done by inverting and rotating the tank in a continuous and rhythmic twisting motion. The proper film agitation motion is infinitely easier to demonstrate than describe. One manual recommends that you use a "quasi-spiral torus motion." I suggest that you find a friendly camera salesperson or photographer and ask him to show you how it's done. You might want to check the salesperson's negatives and prints to see whether he has trouble with development streaks or air bubbles.

   Correct agitation is especially important during the development stage of the process. If the motion you use fails to circulate the developer evenly around your film, your negative will have areas of uneven density that will show in your prints. Jerky or consistently violent agitation movements can create bubbles in the developer that can stick to your film and cause spots. To dislodge any of these bubbles, you should rap your tank against a hard surface after each agitation. Perhaps the most important point to remember about agitation is that **the longer and more aggressively you agitate, the faster your film will develop**. For this reason, it is important that you establish a definite plan for your agitation and follow it religiously. This is especially important during the development and fixing stages of the process. A typical agitation plan would be
   - For developments from 3 to 4 minutes: Agitate continuously.
   - For developments from 4 to 15 minutes: Agitate for 30 seconds, rest for 30 seconds, and then agitate for 5 seconds of every 30 seconds thereafter.
   - For developments longer than 15 minutes: Agitate continuously for 1 minute, rest for the next minute, and then agitate for 30 seconds of every 2 minutes thereafter.

3. **Temperature.** It is very important that you adjust the temperature of the processing solutions before you begin using them. The cooler photo-chemicals become, the less efficient they are. Conversely, the warmer your chemicals are, the faster they will work.

Most photo-chemicals are formulated to work at 68 degrees. If, for some reason, you have to use your chemistry at a higher or lower temperature, consult a time and temperature conversion chart for the correct development time at a given temperature. Such charts are usually provided with your developer.

It is also very important that the temperature of all your chemicals is the same. This includes the water you use to wash your negatives and prints. A more than 1- or 2-degree variation in the temperature of your chemicals can seriously damage the quality of your negatives.

4. **Dilution.** Carefully follow the manufacturer's mixing instructions for all your photochemistry. Inconsistent dilution of your chemistry will make it impossible for you to control or standardize your processing results. Developer or fixing solutions that are either too dilute or too concentrated will drastically affect the amount of time it takes to produce the best results. The rule is: **The more concentrated the developer and fixer, the faster they will work.** Of course, the reverse is also true. The more dilute the photo-chemistry, the longer your processing time will be. (For more information about dilutions, refer to Appendix M.)

As you can see, agitation, temperature, and dilution are processing variables that must be carefully controlled to give your photographic work the consistency you need. When you become more experienced, you will discover that there are advantages to modifying all these controls, but in the initial stages, it's a good idea to consider development time, the only variable that you can reliably control.

FRAME	APERTURE SETTING	
FILM PROCESSING		
Step 1:	Development	3 to 30 minutes
Step 2:	Stop bath	30 seconds
Step 3:	Fixer	5 minutes (check instructions)
Step 4:	Rinse	2 minutes
Step 5:	Hypo clear	3 minutes
Step 6:	Final wash	15 minutes
Step 7:	Wetting agent	1 minute
Step 8:	Dry	

[**note**] The exact development times for film will vary greatly according to a number of factors, including the film you are using, the developer and dilution, and most important, the contrast of the scene being photographed. This subject is covered thoroughly in Chapter 6.

PRINT PROCESSING		
Step 1:	Development	2 to 4 minutes
Step 2:	Stop bath	30 seconds
Step 3:	Fixer	5 minutes
Step 4:	Wash	2 minutes
Step 5:	Hypo clear	2 minutes
Step 6:	Final wash	1 hour (archival)
Step 7:	Dry	

ASA

When film manufactures alter the size and composition of the silver grains in the emulsion, films can be made more or less sensitive to light. The more sensitive an emulsion is, the less light it takes to produce a given density. Very sensitive films are said to be faster than films that are less sensitive because they allow you to use a faster shutter speed in a given lighting situation. Films of various speeds are assigned numbers by the American Standards Association (ASA). They are called ASA numbers. The important point to remember about ASA numbers is that **the higher the film's ASA number, the faster the film**. Thus, a film rated ASA 400 is more sensitive to light than a film rated ASA 125. Faster films tend to be more grainy than slower films, but using them is an advantage when you're shooting in low-light situations.

You will learn much more about ASA and its effect on exposure and development in the main body of this book, but the essential concept is as simple as that. (See Appendix Q.)

Paper Grades

Photographic printing papers were once available in a wide variety of textures, thicknesses, and tonalities. These days, with the popularity of digital image processes it is much easier to find beautiful papers designed for inkjet printing. But, there is still a major distinction between **resin-coated** (RC) papers which require much less washing and dry more quickly and **fiber-based papers**. Fiber-based papers are generally preferred for exhibition-quality printing because they are more archival. There are a number of excellent, exhibition-quality papers currently on the market. They include Ilford Galerie, and Ilford Multigrade. Single-weight papers are less expensive but are more vulnerable to creasing than double-weight papers. "Warm-tone" papers print with a brownish or sepia tone, whereas normal or "cold-tone" papers are more neutral. To become familiar with the variety of papers available, compare the paper sample books displayed at many photo supply stores. But again, it must be said that one of the incentives for converting to digital photography is the wonderful variety of paper surfaces that are available for ink jet printing.

One fundamental characteristic of an analog photographic paper is its **contrast**. Figures G.4A and B illustrate the difference in contrast between two papers of different "grades" used to print the same negative.

FIGURE G.4 Photographic paper contrast examples.

Figure F.4A is "softer" or "flatter" than Figure G.4B and has more gradual transitions from one tonal value to another. Figure G.4B has greater separation between print tones that are relatively close in value. This is especially visible in the background and in the child's face. **Tonal range** and **tonal separation** are two ways of defining the contrast of a photographic print. Although the tonal range of different prints may be the same, meaning that the blacks are just as black and the whites as white, higher-contrast papers separate close tones more sharply. If your film is properly exposed and developed, the choice of what grade of paper to use for a negative depends on your sense of how that negative should be interpreted.

Graded and Multigrade Photographic Papers

Graded printing papers are assigned numbers according to the contrast a particular paper will make from a given negative. The rule is: **The higher the number, the more contrast the paper will have**. These numbers run from 0 for the very low contrast papers to 5 for extremely high contrast papers, although it is difficult to find graded papers other than 2 and 3 and these are relatively expensive.

Photographic papers are still available in two forms: **graded papers** and **variable-contrast** or **multigrade (polycontrast) papers**.

With graded papers, you have to buy a separate supply of paper for every contrast you want.

Multigrade papers allow you to change the contrast of each sheet by using a set of numbered filters. Each filter in the set represents a different contrast grade according to its number. The higher the filter's number, the higher the contrast. For obvious reasons, multigrade papers tend to be more economical. With practice, it's also possible to use two or even three different filters on the same sheet of variable-contrast paper. You can, for example, use a low-contrast filter (number 1 or 2) to print the sky of a given negative and a high-contrast filter 2 (number 3 or 4) for the foreground. Multigrade papers also have the advantage of allowing you to change the contrast by one-half grade steps.

Different brands of paper of the same grade will often have different contrasts. This is due to the difference in manufacturing standards and specifications. It's a good idea to become familiar with the characteristics of one brand of paper before trying another.

A **normal** grade of paper (usually grade or filter 2) is one that will make the best print from a negative that has *Normal contrast*. If the negative you are printing has *less* than Normal contrast, you will tend to use a *higher* grade of paper. If your negative has *too much* contrast, you will want to use a *lower* than normal grade of paper. The problem with this random method of printing is that the further you get from normal-contrast negatives and papers, the more difficult it becomes to control the subtle nuances of tone that make fine prints so beautiful. Ideally, if all your negatives printed well on normal grades of paper, you would be free to use the higher or lower grades for interpreting your images in other, perhaps more creative, ways. Each grade of paper has a unique quality. The secret of fine printing is to discover which grade is best suited to the quality of print you are trying to make and then *adapt the contrast of your negatives to fit that particular grade*. The Zone System is specifically designed to make this possible.

The contrast of a given grade of print is also affected by the paper developer you choose to use. Kodak Dektol is a standard print developer that produces normal-contrast prints when used at dilutions of 1:2 or 1:3.

The Camera

Essentially, any camera is simply a device that uses a lens to focus the light reflected by an object onto a piece of photographic film. It's very important to understand and remember that only a certain amount of this reflected light must be allowed to expose the film. When this is done properly, we say that the film has been given the correct exposure.

THE APERTURE

The camera has two mechanisms that control the amount of light that's allowed to expose the film. The first is called the **diaphragm**. The diaphragm is simply a metal membrane in front of the film with an adjustable hole in it called the **aperture**. **The larger the aperture, the more light it will let into the camera to expose the film.**

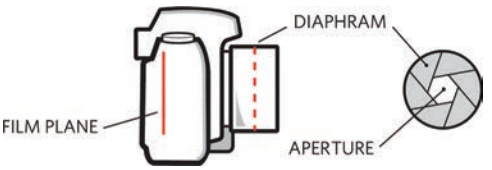


FIGURE G.5 Camera and diaphragm.

The various aperture sizes are measured with numbers called **f/stops**. Typical f/stop numbers are f/1.4, f/2, f/2.8, f/4, f/5.6, and f/8. You must remember two rules relating to f/stops:

1. The larger the f/stop number, the smaller the opening of the aperture. Thus, f/8 represents a smaller aperture (and less exposure) than f/5.6. A simple way to remember this is to consider f/numbers as you would ordinary fractions: 1/16 of a pie is smaller than 1/2 of a pie.
2. The second rule relates to what is called **depth of field**. When you focus a camera on a given object, any object that is equally distant from the camera will also be in focus. This distance is called the **plane of sharp focus** (Figure G.6).

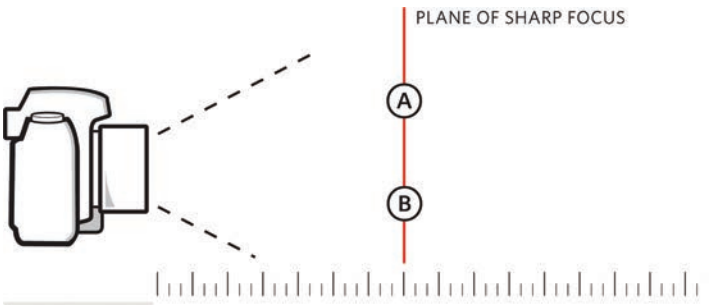


FIGURE G.6 Objects A and B are in focus.

Any object that is within a certain distance in front of or behind this plane will also appear to be in focus. This range of distance within which objects appear to be in focus is called the depth of field. The farther an object is from this depth of field, the more out of focus it will be.

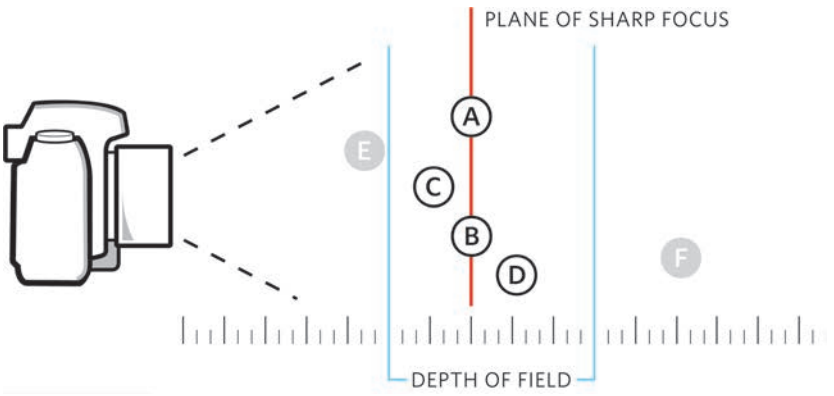


FIGURE G.7 Objects C and D are in focus. Objects E and F are out of focus.

The amount of depth of field depends on the size of the aperture. **The smaller the aperture, the greater the depth of field.** Thus, f/8 will give you more depth of field than f/5.6.

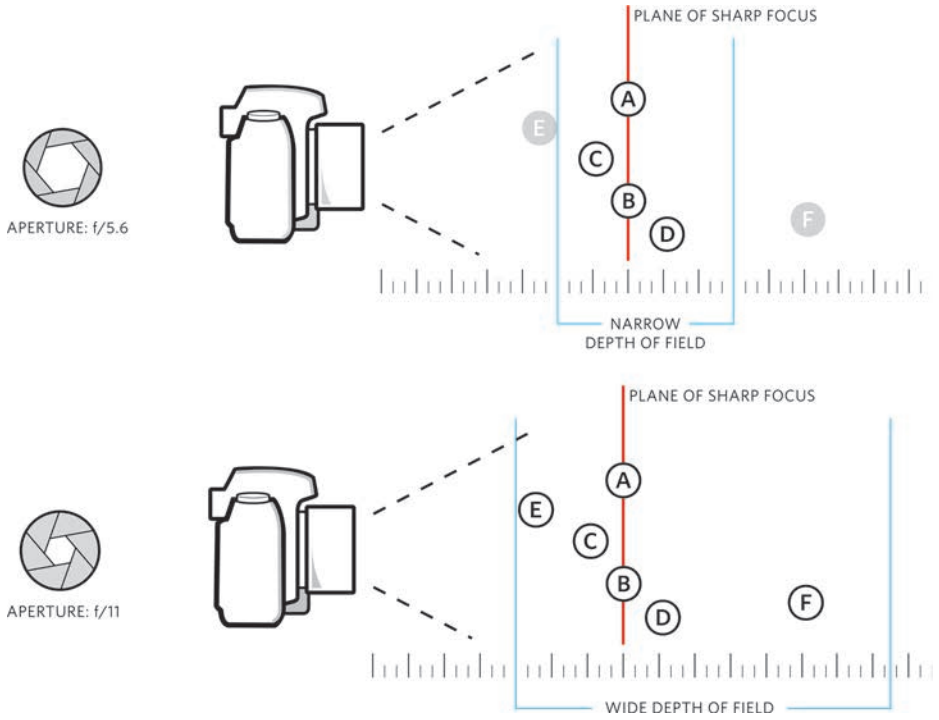


FIGURE G.8 Depth of field increases from f/5.6 to f/8.

This concept is important to know because there are times when you will want as much depth of field as possible and others when you will want to use a selective focus to isolate objects in a given scene.

THE SHUTTER

The second mechanism that the camera uses to control the amount of light that exposes the film is called the **shutter**. The shutter is a device that determines **how long** the film is exposed to the light that passes through the aperture. **The longer the shutter is open, the greater the exposure.** The shutter is controlled by setting the shutter speed dial. Typical shutter speeds are 1/60, 1/30, 1/15, and 1/8. These numbers represent fractions of a second. Because 1/60 of a second is less time than 1/30 of a second, it is said to be a *faster* shutter speed. Shutter speeds faster than 1/60 are useful for making objects that are moving appear sharp, and also for helping prevent camera motion from blurring the image. As a rule, you should try to avoid using shutter speeds slower than 1/30 of a second when you are shooting without a tripod.

Exposure

By using the correct combination of f/stop and shutter speed, you can give the film the proper exposure for any photographic subject. (See Chapter 5 for more information on this subject.)

The correct exposure for a given picture is determined by using a **light meter**. A light meter performs two basic functions. The first is to measure the amount of light that is falling on the subject (this is called incident light) or the light that is reflected by the subject. The function and uses of various types of light meters are discussed in Chapter 5. For our purposes, the handheld reflected-light meter is the most useful.

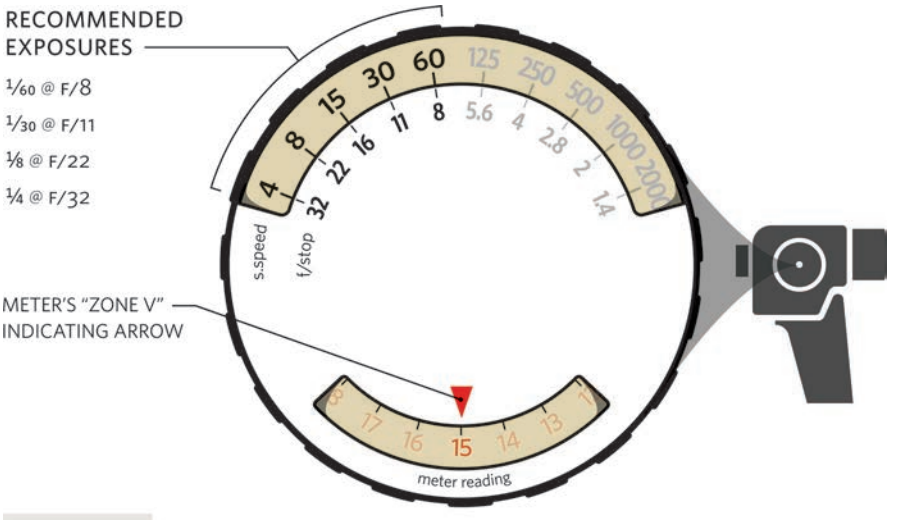


FIGURE G.9 A handheld light meter and its recommended exposures.

The first step for determining your exposure is to set the meter's ASA dial to the ASA number of the film you are using. Carefully read the owner's manual that came with your meter to see how this is done. Next, it's very important that you carefully aim the meter at the subject you are photographing. Ideally, the meter should "see" exactly what the film will see when the picture is taken. When the meter is activated, an arrow or needle of some kind will swing to the meter number that represents a measurement of the amount of light reflected by the subject. The important point to remember about light meters is that **the higher the number, the greater the amount of light being measured**.

The next step is to use the meter's exposure dial to determine the correct exposure. You do this by turning the movable wheel on the dial until the meter's indicating arrow is matched against the number chosen by the meter. At this point, you will see that the meter is recommending a wide range of f/stop and shutter combinations for you to use.

In this example, any of these combinations of f/stop and shutter speed will give you the same exposure. This is true because **any given f/stop and any given shutter speed both allow the same amount of light to enter the camera**. (The one exception to this rule is explained in Appendix R in the section "The Reciprocity Effect.")

If the meter recommends an exposure of f/11 at 1/30 of a second, f/16 at 1/15 of a second will let the same amount of light into the camera. This may sound confusing, but it will make sense if you think about it for a moment. F/16 is one-half the aperture size of f/11, but 1/15 of

a second allows f/11 to stay open for twice as long. This means that the combination of f/stop and shutter speed that you choose should be based on whether depth of field or stopping motion is more important to the picture you want to take. If you want an exposure with greater depth of field, you will choose a combination with a smaller aperture (in other words, a higher f/stop number). If you are photographing moving objects, you should choose an exposure with a faster shutter speed.

HANDHELD LIGHT METERS

Let's summarize the general steps for determining an exposure with a handheld reflected-light meter:

1. Set the film's ASA into the meter.
2. Carefully aim your meter at the scene.
3. Turn the meter's indicating arrow until it matches the number chosen by the meter for that lighting situation.
4. Select a combination of f/stop and shutter speed to use for setting the camera according to the following rules:
   a. If you want great depth of field, choose an exposure with a small aperture (a high f/stop number).
   b. If you are shooting moving objects or handholding the camera, choose an exposure with a fast shutter speed.
5. Set your camera to the exposure you have chosen and shoot the picture.

IN-CAMERA LIGHT METERS

In-camera meters base their exposures on the light that enters through the lens of the camera. This is an advantage in many ways, but a disadvantage in others. Because the meter is measuring the same image you see through the viewfinder, you can easily aim the meter properly to include exactly what you want it to see. Built-in meters are also very light, and when combined with modern automatic cameras, they are easy to use.

There are many different types of in-camera meters. For this reason, it's very important that you know which features will best suit your needs before you buy a particular camera. (See Chapter 7, page 83–84 for a more detailed discussion on this subject.)

FULLY AUTOMATIC CAMERAS

Fully automatic cameras choose a combination of f/stop and shutter speed to expose a given scene. Often there is no way for the photographer to know what the actual exposure is. Although these cameras are easy to use, they make it impossible for you to exercise any creative control over the photographic process.

SEMI-AUTOMATIC CAMERAS

There are two general types of semi-automatic cameras: aperture preferred and shutter preferred. Cameras with aperture priority allow you to choose the f/stop you prefer for a given scene while the meter chooses the shutter speed. Usually, the shutter speed is displayed in the

viewfinder so that you can determine whether it is fast enough to stop any motion that may be in your picture. Shutter-priority meters automatically select an aperture for every shutter speed you choose.

One general problem with both fully and semi-automatic cameras is that whichever method the meter uses, you're still locked into using the exposure chosen by the camera. In many cases, this exposure will be adequate, but it prevents you from being able to adapt the exposure to suit your own interpretations. In general, as you become more involved with the process of taking better photographs, you will find that any system that limits your choices will be less desirable.

Needless to say, there is a great deal to be said about the process of exposing your film correctly.

Appendix **H**

Films, Developers, and Processing

With the digital revolution in full swing, it feels almost nostalgic to be writing about films and developers. But the fact remains that there are still many photographers for whom silver-based processes are the absolute standard for quality and the work they produce can be exquisite. A good example of the persistence of classic black-and-white photography is the reemergence of Rodinal, albeit with a new name, Adonal. In 2006, at the writing of the previous edition, I included a memoriam to the passing of this remarkable developer. Since then, in 2008, there was enough demand for its unique qualities that its formula has been revived, so I can once again recommend its use.

Despite what advertising may suggest, no film or developer is ideal for every use. Developers and films all have very specific qualities that are best suited to particular applications. Your goal should be to define the kind of photography that you intend to do and decide on the appropriate materials.

As you begin this process, it's easy to feel that you may never learn enough about all the various developers and films available and their effects. There is, in fact, a much more direct and practical way to approach this problem. What most photographers actually do is look at the work of a photographer they admire and use the film and developer that photographer uses, at least as a starting point for their own work. This approach not only gives you a concrete model to follow, but also enables you to learn the pitfalls and limitations of a particular film/developer combination.

It is for this reason that I have decided to give you as much practical information as I can about what different films and developers will do. Of course, not every available film and developer is included in this appendix, but the ones I have chosen cover most of the major products available in the United States and, more important, all the major categories of films and developers that are made. As I mentioned at the beginning of Chapter 9, there have recently been significant changes to a number of the most revered traditional photographic products. Comments on some of these issues are included in the following sections.

The first section here, "The Basics," describes the general categories of films and their uses. If you're already familiar with these basic concepts, skip this section and refer to the sections "Developer Notes," "Film Notes," and "Processing Notes" for more detailed information. The section "Film and Developer: Questions and Answers" in Chapter 9 summarizes my personal evaluations of how certain films and developers actually perform.

After you have chosen a given developer and film, stick with them until you're sure that you understand their advantages and disadvantages; only then should you begin experimenting with different variations. In the end, you will find that the simpler your tools and methods, the easier it will be for you to accomplish your photographic goals.

The Basics

Both films and developers fall into natural categories that make it easier to decide which combination is best for you.

FILMS

There are three basic categories of films. They depend on the quality of the grain that appears when the negative is enlarged and the speed or sensitivity of the film to light. (If you aren't familiar with the relationship between ASA and image quality, refer to Appendix Q and Appendix G for its primer on basic photography. See a later section in this appendix for a discussion of tabular grain films: T-Max and Delta.)

Fine-Grain Films

If you're shooting well-lit landscapes, still lifes, or non-candid portraits with roll film, you will probably want to use a tripod and a relatively slow-speed, high-acutance fine-grain film such as Kodak T-Max 100, Ilford Delta 100, or Ilford Pan-F Plus. (Keep in mind that these recommendations are only guidelines for general use. The rule is: Anything that works in art is fair.) Slower films tend to have finer grain and more inherent contrast than films with higher ASA numbers. This is why, in situations where film speed isn't a factor, most photographers try to use as slow a film as possible.

High-Speed Films

If you're shooting in low-light situations or taking pictures of moving subjects, you'll need a faster film such as Kodak Tri-X 400TX, TMY 400TMax, Ilford Delta 400, or Ilford HP5 Plus. Highspeed films have more grain and less inherent contrast than films with lower ASA numbers. Those shooting with view cameras should remember that fast films such as Tri-X 400TX are grainy only when the negative is greatly enlarged. In extreme low-light level situations where maximum film speed is the priority, films such as Kodak T-Max P3200 TMZ are ideal.

Medium-Speed Films

Medium-speed, semi-fine-grain films are designed for average situations where a high-speed or fine-grain film isn't required. Kodak Plus-X 125PX and Ilford FP4 Plus are good choices.

All these films are excellent when handled properly.

DEVELOPERS

The speed and grain characteristics of various films make choosing the right one fairly simple. Selecting the best developer is more complex for two basic reasons: There are dozens of good brands and different types of developers to choose from, and there is a general lack of objective information about what a particular developer will do. A good general rule is: Find a photographer whose work you admire and use the developer that photographer uses.

Generally, developers fall into three basic categories: fine-grain, general-purpose, and exotic.

Fine-Grain

Fine-grain developers are ideal for negatives that need to be greatly enlarged. Unfortunately, these developers tend to produce negatives that appear less sharp. They also give you less film speed than standard developers. Some recommended fine-grain developers are Acufine, Ilford Perceptol, and Microphen.

General-Purpose

Standard developers are excellent for most films and ordinary lighting situations. The slightly increased grain that you get with these formulas is only a problem if you are making very large prints. Kodak's HC-110, Ilford's Ilfotec HC, and Kodak's T-Max developers have the added advantage of being concentrated liquids. Using liquids eliminates having to dissolve powders in heated water before using them. Recommended standard developers: Kodak XTOL, Kodak HC-110, Kodak D-76, Ilford ID-11, and Kodak T-Max and T-Max RS.

Exotic, Make-It-Yourself Formulas

Exotic developers are for adventuresome photographers looking for the ultimate developer for special purposes. The variety of different formulas available is staggering. (For more information, consult *Basic Photographic Materials and Processes*, second edition (Kindle edition), published by Focal Press; *The Negative*, by Ansel Adams; or *The Photo-Lab Index* (the last edition of this classic was published in 1994, but it's worth having if you can find a used copy).

Developer Notes

KODAK XTOL is a powder that comes in two parts that can be mixed at room temperature. Designed as a general-purpose developer, it gives very good film speed, fine grain, and good contrast. Be sure to mix XTOL precisely as recommended by Kodak and, although I suggest using this as a one-shot developer, it can be "self-replenishing." (See note below.)

[**note**] All developers exhaust themselves as they are used due to the accumulation of residual byproducts as you process film. Some are designed to be "one-shot" developers that you discard after using them once. This quality guarantees that you're always using fresh developer, which is vital for consistent results, but this is clearly not the most economical or ecological darkroom practice. For this reason, many photographers and photo labs use developers that can be "replenished," which means that they can be brought back to full strength by adding a carefully measured amount of a special, concentrated batch of the same developer brand.

"Self-replenishing" developers like Kodak's T-Max and XTOL have the advantage of allowing you to replenish them with a batch of developer mixed to the same dilution as your normal solution. You do this by simply bringing the volume of developer back to your normal amount, usually one-half or one full gallon.

KODAK D-76 is a general-purpose developer sold as a powder. It can be used either straight, as a stock solution (diluted from powder), or diluted one part stock to one part water. D-76 gives slightly finer grain and can be replenished when used straight.

ILFORD ID-11 is very similar to D-76 but gives finer grain and is good for Expansion developments.

KODAK HC-110 is an excellent all-purpose developer that comes in liquid form, which makes it quick and easy to use. HC-110 works well with Kodak T-Max P3200, giving good film speed and contrast. Kodak lists a number of dilution possibilities for HC-110 on the bottle. Dilution B is one part stock solution to seven parts water (1:31 from concentrate).

ILFORD ILFOTEC HC (High Concentrate) is a liquid developer similar to Kodak's HC-110, although my tests show that it gives slightly less film speed.

ILFORD PERCEPTOL is a softer-working, fine-grain developer that is useful for Contraction developments because of its relatively long Normal Development Times.

KODAK T-MAX is an excellent and versatile high-energy developer designed specifically for Kodak's T-Max films. T-Max gives good contrast and film speed with any film, but it is especially good with T-Max 100 and 400 when used at 75 degrees. T-Max developer comes in a liquid stock solution that is mixed 1:4 for a working solution.

[**note**] Kodak T-Max developer isn't recommended for use with any sheet film. Occasionally, a dark, blotchy coating called "dichroic fog" will appear on the emulsion side of your film and can be removed only by vigorously washing the film by hand, which carries the risk of scratching the image. Because roll films don't use the same adhesive coatings as sheet film between the emulsion and the film base, dichroic fog isn't a problem when T-Max developer is used with roll films.

KODAK T-MAX RS developer is very similar in quality to T-Max developer except that it produces negatives with slightly more contrast.

T-Max RS is formulated to be self-replenishing. (See the previous note about self-replenishing developers.) Kodak recommends replenishing at a rate of 1 1/2 ounces per roll processed. This system is easy to use and has the advantage of making it impossible to over-replenish. When the second half gallon is finished, you can assume that the developer is exhausted and ready to be replaced.

Unlike T-Max developer, T-Max RS developer is recommended for sheet film because it is designed for use in machines and contains buffers that prevent the silver from replating on the surface.

Film Notes

THE OLD VERSUS NEW KODAK FILM CONTROVERSY

As I mentioned at the beginning of Chapter 9, there has been a great deal of confusion and some controversy about the extent to which Kodak's films have changed. What is clear is that Kodak's emulsions needed to be modified to accommodate the relocation of the plants they use to apply the emulsions to their film bases (or the "coating alleys," as they are known). Many photographers have discovered that prints made from these new films have more pronounced grain and harsher tonal gradations than the old films, and empirical tests have confirmed these results. For reasons that aren't clear, this effect seems more dramatic when the new Kodak films are processed in Kodak D-76, a developer that was once the standard for many photographers. Our tests indicated that these new films have much better speed and contrast characteristics when processed in Kodak XTOL and T-Max developers. This is especially true for Kodak's 100Tmax (T-Max 100) and 400Tmax (T-Max 400) films.

TABULAR GRAIN FILMS: T-MAX AND DELTA

By applying Tabular Grain or T-Grain technology to black-and-white emulsions, Kodak and Ilford have produced films that have substantially less grain than standard emulsion films. "Tabular" refers to the much larger and flatter shape of the silver crystals in the emulsions of these films. The greater light absorption qualities of these flat crystals allow the manufacturer to produce a thinner emulsion that results in substantially finer grain.

Kodak's T-Grain films are T-Max P3200, 400Tmax, and 100Tmax. Ilford's T-Grain films are Delta 100 and Delta 400. The finer grain and excellent image quality of these films will no doubt make them very popular with serious photographers, but my test results indicate that T-Max and Delta have unusual characteristics that should be given special attention.

1. I found 400Tmax and 100Tmax and Delta 400 and 100 to be no faster than 400TX (Tri-X) or 125PX (Plus-X), respectively. The advantage of T-Grain films is that they have substantially finer grain. The 100Tmax film has grain as fine as the old Kodak film Panatomic-X, but 100Tmax is much faster.

   T-Grain films are also extremely unforgiving of underexposure. The 400Tmax and 100Tmax look best when developed in T-Max or T-Max RS developer at 75 degrees, but be sure that you place your Important Shadow Area no lower than Zone III on the scale.

   Never use T-Max developer with sheet film. (See the information on Kodak T-Max under the section "Developer Notes.")
2. T-Grain films are extremely sensitive to changes in development time, temperature, dilution, and agitation rate. Inconsistencies in any of these variables will produce noticeable changes in the contrast of your negatives. For this reason, T-Max films are very useful for Expansion and Contraction developments. Make an effort to be as consistent as possible in your development procedures.
3. Because T-Grain films are unusually responsive to changes in development time, the normal Expansion and Contraction formulas don't apply to these films. (See the section "Expansion and Contraction Development Times" at the end of Chapter 8 for details.)

4. Kodak indicates that T-Max films require less compensation for the reciprocity effect than do conventional films. Ordinarily, when your indicated exposure is 10 seconds, a 50-second exposure is required, with a 20 percent reduction in your development time to avoid underexposure and overdevelopment. With T-Max, Kodak recommends an exposure of only 15 seconds for a 10-second indicated exposure, with no reduction of your development time (see Appendix R). Standard reciprocity failure charts apply to Ilford's Delta films.
5. Longer fixing and washing times are required with T-Max films to clear special dyes added to the emulsion. These dyes will turn the fixer red and exhaust it faster than normal. Ilford's "Core-Shell Crystal Technology" allows Delta 400 and 100 to have the advantages of a T-Grain emulsion without the special dyes that cause T-Max films to stain the fixing bath.

CHROMOGENIC FILMS

The chromogenic class of films is based on C-41 color negative developing processes. These films have characteristics that are substantially different from normal black-and-white materials. As of this writing, Ilford's XP2 Super Black and White is the only remaining chromogenic film available.

1. Because the images in a chromogenic negative are made up of densities of black-colored dye instead of particles of silver, they are less grainy.
2. Overexposure tends to reduce the appearance of grain because as the density of the negative increases, the microscopic spots of dye merge to form a continuous image. This allows a great range of exposure latitude when working with these films; usually ASAs between 25 and 1600 can be used on the same roll with satisfactory results.
3. Because chromogenic films must be processed to C-41 color standards, you can't alter the development time to compensate for changes in subject contrast.
4. Because chromogenic films are designed to be printed on color papers, you'll need much longer times and higher contrast settings when used on black-and-white papers.

Processing Notes

A number of factors will affect your development time. Please keep the following in mind.

AGITATION. The longer and more aggressively you agitate the film in the developer, the shorter your development time will be. Consistency is very important. My agitation plan for roll film is as follows:

- Constant agitation for the first 30 seconds.
- Rest for 30 seconds.
- Agitate 5 seconds for every 30 seconds up to the total development time.

(See Appendix G for a primer on basic photography.)

DILUTION OF THE DEVELOPER. It's extremely important that you accurately measure your chemistry every time you process your film. Changing the dilution has a dramatic effect on the contrast of your negatives. Very dilute developers reduce negative contrast. Higher concentrations increase contrast. (See Appendix M.)

[**note**] Jobo processors automate the agitation process by giving the film constant agitation. For this reason, your Normal Development Times will be approximately 15 percent shorter when using these processors.

TEMPERATURE. After you establish a working temperature for your chemistry, make sure that you don't stray from this standard by more than one degree.

TANK VERSUS TRAY DEVELOPMENT. This advice applies to sheet film users only.

With the **tray method**, the individual sheets of film are agitated continuously by a hand in a tray of developer. Use a tray that is large enough to allow easy handling of the film. Trays with flat unchanneled bottoms aren't recommended. This method uses less developer than the tank method, and because the agitation is constant, the processing times are shorter. Presoaking the film in a bath of 68-degree water will prevent the sheets from sticking together when you put them into the development bath. When the film is presoaked, you should add 30 seconds to the development time. Extreme care must be taken to avoid scratching the emulsion side of one piece of film with the corner of another. Also be careful not to touch a dry sheet of film with your wet fingers. The safest method for developing sheet film in a tray is as follows:

1. Fan the dry sheets so that they can be grasped individually.
2. Quickly immerse the film face up one shot at a time in the presoak bath to avoid trapping air bubbles against the emulsion.
3. When you move your film from the presoak bath to the developer, place each piece of film face down and keep the film from floating around.
4. To agitate, pull the bottom sheet out and move it to the top.
5. Keep repeating this process for the duration of the development time. Make sure that the sheets remain face down. This will protect the emulsion side of the film from being scratched.

With the **tank method**, the sheets are first put into individual metal hangers and then are developed together in an upright tank. To agitate sheet film in a tank, use the following method:

1. At the beginning of your development, slowly lower the hangers together into the development tank.
2. Tap them sharply against the top of the tank to dislodge any air bubbles that may be on the surface of the film.
3. Lift the hangers out of the developer together and tilt them to the side until the excess developer has run back into the tank.
4. Re-immerse the film and repeat step 3, tilting the hangers in the opposite direction.
5. Repeat steps 3 and 4 for the first 15 seconds of every minute, following the agitation plan outlined above.

Proper sheet-film agitation requires careful planning and precision. Before you attempt either tray or tank development, I suggest that you ask an experienced film processor to demonstrate how it's done.

Whichever method you use, always use fresh developer and develop the same amount of film in your tank or tray when possible. The more film you process in a given amount of developer, the faster the developer will be exhausted.

Appendix I

The Practical Zone System Film and Developer Testing Method

Many years ago as I was learning the Zone System, I went through the frustrating process of designing home film and developer testing methods that attempted to reproduce the procedures I read about in articles and technical books. This included building handmade densitometers out of wooden index card boxes and setting up lights in my musty basement; none of these approaches were either simple enough or precise enough to teach me what I wanted to know or how all this applied to the photography I wanted to do. Eventually, I learned enough by trial and error to make the system work well, but when I decided to write the first edition of this book, I knew I needed a better solution to this problem.

The challenge was to create a film and developer testing method that was precise and consistent enough to give me accurate results, pragmatic enough to include all the factors that operate for photography in the real world, and efficient enough to allow me to test many different film brands in a variety of different developers.

The following is a description of the process my collaborator and I used to prepare the test results published in this book, but first I want to acknowledge the indispensable support provided by Kodak and Ilford for their generous donation of hundreds of rolls of film over the years. Most especially, I want to acknowledge Iris Davis, whose custom labs have provided the setting for all the developing and printing involved, and whose enthusiasm and patience helps make this all possible.

The Testing Process

First, let's consider the objectives of this process. My goal was to see exactly how a wide variety of films behaved at a range of different ISO settings, when processed in an equally wide array of developers. A key to the success of this process was building a testing target that contained very

easily identifiable swatches of all the important Zones. Years ago I walked into a large fabric store in Austin, Texas, with my spot meter and a gray card. To create swatches of the important Zones, I compared selections of very fuzzy towel fabrics until I found a set that reflected light in such a way that they fell exactly across the Zone Scale when evenly lit. (Needless to say, the proprietors of the store were very patient with all this strange behavior.)

Figure I.1 shows the result. Rough but very effective.

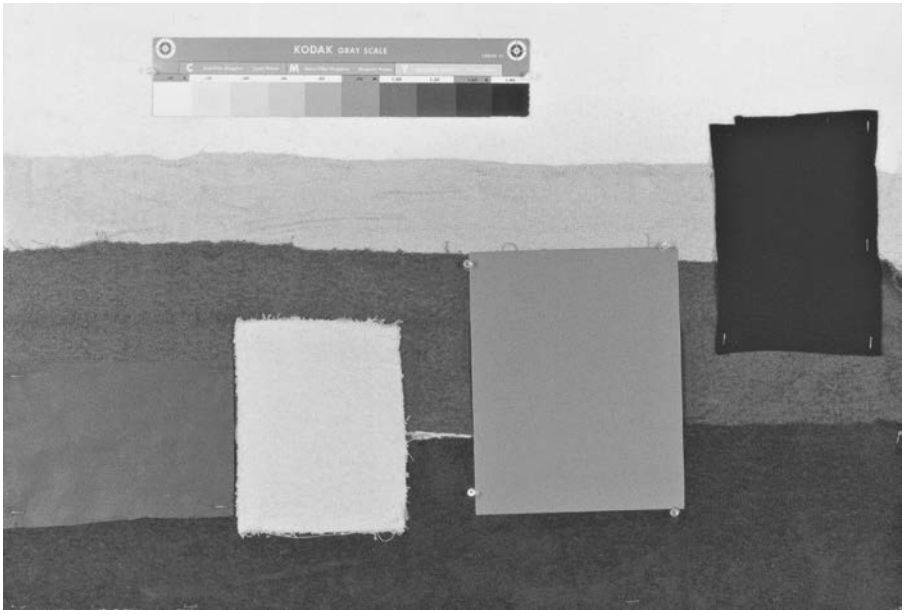


FIGURE I.1 Zone System film testing target.

After acquiring all the film and developer I needed, the next step was to set up my target in a lighting studio and make sure that my reflected meter readings all fell appropriately on the Scale. I paid special attention to the placement of Zones V, represented by the Neutral Gray Card, and the large areas of Zones III and VIII.

Once this was done and the image was focused, I proceeded to very carefully expose the requisite hundreds of rolls of film according to a precise bracketing system that was exactly equivalent to shooting the film at a range of different ASA/ISO settings. I also left a number of frames blank for reasons that will soon be clear.

[**note**] The principle behind this step is described in Chapter 8 in the section "The Use of Equivalent ISO (ASA) Numbers."

After all the film had been shot, the next step was to make an informed guess at what development time in a given developer gave us the highest film speed that rendered adequate detail in the Zone III textured swatch.

This is a very important decision. You get very different results if your goal is simply to render the Zone V card as a specific negative density and print value. This is essentially what film manufacturers do, which goes a long way toward explaining why my test results are often different from most published standards. Exposing and developing for good detail in Zone III means that your film speed is likely to be lower than the gray-card-only method. The advantage of testing this way is that it's much closer to the concerns of photographers working in the real world. If, for example, your standard film speed doesn't give you acceptable detail in the shadow areas, you will have the feeling of consistently underexposing your film.

After a given roll of film had been processed, I then clipped a large section of blank film and positioned it in the negative carrier so that it covered only half of the opening.

This procedure allowed us to create a test print of short exposures where the side printed with open light turns black first, which gave us an easy way to determine the minimum time that produces the maximum black.

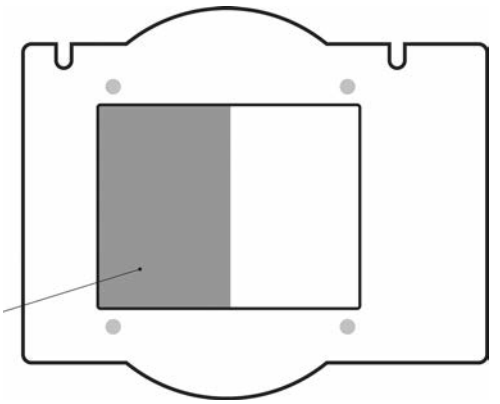


FIGURE I.2 Negative carrier with blank frame half inserted.

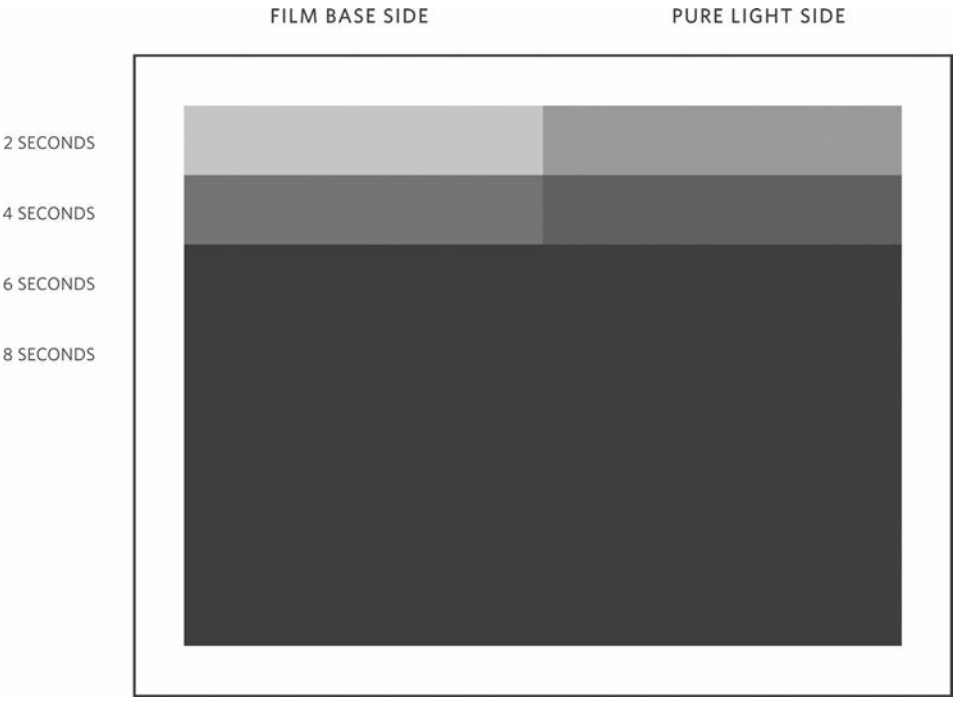


FIGURE I.3 Illustration of minimum time/maximum black test.

This minimum time/maximum black test needs to be done for every test roll to compensate for the film base fog that varies from one roll of film to another. When this time is determined, we simply make a straight print of all the bracketed exposures using this time and look closely to see which ASA gives us the detail we want in the Zone III area of the target. Because the test prints were all exposed for the same amount of time but were shot at different equivalent ASA settings, it's very easy to see which film speed renders the shadow textures the way we want them to be. We then label these prints with all the relevant information.

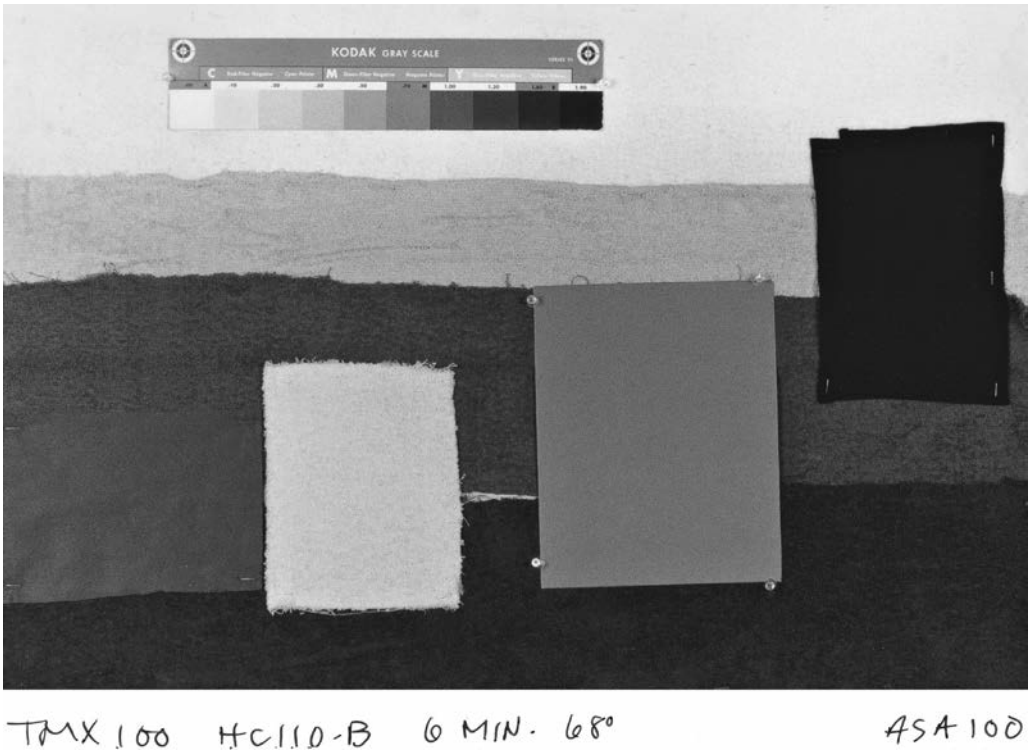


FIGURE I.4 Zone System film/developer test print.

If the Zone VIII swatch of this print had good texture and detail, then we knew that the development time used for that roll was our new Normal Development time for that film and developer combination. If not, then we would have to go back and process one of the many backup rolls for a longer or shorter time until the highlights were rendered properly.

One advantage of this approach to film developer testing is that even the bad prints are useful for determining the Normal Plus and Minus times.

As you can see, this variation on the Zone System Testing Method 1 in Chapter 8 is designed for mass production, but the principles are the same. As time and labor consuming as this approach can be, it yields a tremendous amount of valuable information.

Appendix J

Film and Developer Commentary by Iris Davis

When we last ran our tests in 2006, the digital age was in full swing but film was still a viable and regular option for many, if not most, photographers. That is not the case now. Film is still readily available; however, it is hardly practical for most commercial applications.

We have always been a society enamored of instant gratification, and the digital age has made that possible in the world of photography as well as many other walks of life. What used to involve the coating of glass plates with photographic emulsion, much setup time of tripod and large format camera (for that's all there was), watching existing light until it was "just right," processing the plates in an onsite darkroom, drying, and then contact printing (on paper one had also coated with emulsion) can now take place, literally, in the blink of an eye.

Digital photography has also given photographers a degree of control over their own work that simply wasn't available to most in the past. There really is nothing in the world like a good Cibachrome print, but honestly, how many of us ever had that capability? Now it is possible for just about anybody with a decent digital camera to capture an image and make their own acceptable print from their desktop printer. While we have gained much, I do have to wonder what we are losing.

Printing, in a darkroom, is a holistic experience. It involves mind, body, and all senses. The physical aspect of it is often overlooked until one has made a print where you've had to use your entire arm as a dodging tool on a 20x24 or even, for that matter, stood for 6 or 8 hours printing 8x10s. I feel that the act of putting one's body into the making of the print, handling the fragile photographic paper in the womb-like atmosphere of the darkroom throughout the process of exposure, development, washing, etc., gives a photographer and/or printer a connection to the image that goes beyond that which they gain naturally from creating the image.

I will leave the argument of what is better, film or digital, silver or inkjet, to others. Myself, I'm touting the actual process. Ansel Adams said, "The negative is comparable to the composer's score and the print to its performance. Each performance differs in subtle ways." For me, that is

what makes a darkroom-made print seem more handmade than a computer-generated one. No doubt, it is a personal bias; I also own a typewriter.

Any photo supply store worth its name still sells film, and there are photographers, old-timers and those new to the art, who are finding the unique beauty of the medium. While there are fewer choices for film, paper, and chemicals, a number of manufacturers have shown a strong commitment to traditional photography. I use Ilford papers almost exclusively, and when I shoot, I usually shoot HP5+ in all formats—35mm to 4x5—and it comes in sizes up to 8x20, and yes, I mean inches.

Kodak no longer makes black-and-white silver-based photographic paper. I do like Kodak's T-Max 400 film, and I use T-Max developer for a number of films I see in my lab, most notably the aforementioned T-Max 400. T-Max developer is also very good for pushing film. I use it to push HP5+ to ASA 1600 with quite good results. Kodak T-Max 100 is probably the most reliable mid-speed film on the market. I have never had decent results with FP4 from Ilford. I'll admit I don't branch out in recommending other film manufacturers. I have seen too many inconsistent results and haven't done exhaustive tests on any other brands.

Photographer's Formulary is a very good resource for uncommon chemicals, pre-made and make-your-own such as developers and toners. A priceless toning resource is Tim Rudman's *The Photographer's Toning Book*, which is aptly subtitled "The Definitive Guide." Another resource without which I would be lost is the "Massive Development Chart" on digitaltruth.com. It is an amazing compilation of manufacturers' recommendations for processing any film in any developer. I can say with a great degree of certainty: Using that chart, combined with Chris's and my tests in this book, will get you well-developed negatives every time.

Iris Davis, with unique style and class, owns and operates a quality custom photo lab called Davis Black and White in Austin, Texas. She welcomes questions and comments through her website: www.davisblackandwhite.com/.

Appendix **K**

Alternative Methods for Extreme Expansion and Contraction Development

Expansion

With modern films and developers, Expansions beyond N + 2 are difficult to achieve without a serious loss of image quality owing to increased grain and fog. In general, you should rely on higher than normal paper grades and/or negative intensification when extreme Expansion is required.

Intensification means processing the film through a special chemical bath with the intention of increasing the contrast of the negative after it has been developed and fixed. Ideally, intensification will add density to the highlight areas of the negative without greatly increasing grain. Photographer's Formulary offers a prepared formula called Chromium Intensifier that requires you to bleach, intensify, and then redevelop your negative. This formula is effective, but a more simple method is to intensify the negative in a bath of selenium toner. To intensify negatives in selenium, do the following:

1. Presoak the negative in a bath of water for 5 to 10 minutes.
2. Refix in a bath of hypo without hardener for 5 minutes.
3. Tone in a bath of Kodak Rapid Selenium Toner diluted 1:3 with hypo clearing agent for 5 minutes. Agitate continuously.
4. Clear in hypo clear and wash.

[**note**] Selenium toner is highly toxic. You should perform this procedure in a well-ventilated area. Read the instructions carefully.

Contraction

A number of techniques are available when extreme Contraction is necessary to control the contrast of a very high contrast subject.

1. You may have to use a lower than normal paper grade.
2. If used properly, a **compensating developer** will lower negative contrast while minimizing the loss of shadow detail.
3. The **Two-Bath** and **Water Bath** development techniques can sometimes be useful for extreme Contractions.

All these processes are described in detail in succeeding appendixes.

It's important to remember that there will always be some loss of shadow detail when Contractions beyond N – 2 are necessary. You can compensate for this by placing your Important Shadow Area on Zone III 1/2 or Zone IV when you are planning an extreme Contraction.

Appendix L

Contrast Control with Paper Grades

For historical and technical reasons, paper grade 2 (or multigrade filter 2) is usually considered Normal for negatives with Normal contrast. For example, this is the grade of paper I used as the standard for my testing procedure (see Chapter 9). This means that paper grade 2 would become the target of all of your Zone System negative contrast adjustments, and theoretically your negatives would print well on that grade.

On the other hand, it is possible to customize your Normal Development Time so that any grade of paper becomes Normal for you when you use a given film/developer combination. Experienced fine printers often do this because they have learned that a particular grade of paper best suits their aesthetic needs.

The general principles for adapting your Normal Development Time to fit a given grade of paper are discussed here.

When compared to a standard Normal Development Time on grade 2, the higher the grade of paper you choose as your personal Normal grade, the shorter your personal Normal Development Time will be with a given film/developer combination. The reason is that paper grades with more contrast (higher grade) require negatives with less contrast (a shorter Normal time).

Conversely, the lower the grade of paper you choose as your personal Normal grade, the longer your personal Normal Development Time will be for a given film/developer combination. The reason is that paper grades with less contrast (lower grade) require negatives with more contrast (longer Normal time).

Of course, there are practical limits to how far you can take this process, and the only way to know precisely how much shorter or longer your time should be is to carefully do a test like the one outlined in Chapter 8, page 88.

After you've established your personal Normal grade of paper, and a corresponding personal Normal Development Time, it becomes possible to use paper grades that are higher or lower than this new Normal grade to achieve contrast control beyond the usual Expansion and Contraction methods described in this book: One grade higher than your Normal grade is roughly equivalent to the effect of N + 1; one grade lower than your Normal grade is roughly equivalent to the effect of N – 1.

[**note**] The type of enlarger you use is also a factor in this process. The same negative will produce a print with approximately one grade more contrast when printed with a condenser enlarger than with a diffusion or cold-light enlarger (see Appendix P).

My recommendations here are hedged because paper grade numbers aren't strictly standardized among manufacturers. Printing the same negative on grade 3 of one brand of paper may give you the same contrast as grade 4 of another brand. This use of higher and lower paper grades can enhance the effect of Expansion and Contraction.

For example, if you are photographing a subject that you determine requires N + 3 development, which is beyond the range of normal Expansion techniques, you should give the negative N + 2 development and then print that negative on a grade of paper that is one grade higher than your personal Normal grade. This will result in a print that is approximately equivalent to N + 3.

Conversely, if you are photographing a subject that you determine requires N – 3 development, which is beyond the range of normal Contraction techniques, you should give the negative N – 2 development and then print that negative on a grade of paper that is one grade lower than your personal Normal grade. This will result in a print that is approximately equivalent to N – 3.

Careful testing is required to perfect this technique with your preferred materials. One reason that paper grade 2 or filter 2 is generally considered best for your Normal standard is that it's in the middle of the range of contrast choices available with most papers. Standardizing your negatives to grade 2 will give you the widest number of choices above and below that grade for creative contrast control.

Appendix **M**

Developer Dilution

A number of film developers are specifically formulated to work well at a variety of dilutions. The following is a list of some popular developers and the dilutions at which they are commonly used:

Kodak HC110	1:3 to 1:30
Ilford Ilfotec HC	1:31 to 1:47
Kodak D76	1:1 or undiluted

Recommended Normal Development Times and mixing instructions are provided with all of these formulas.

Changing the dilution of a given developer has a dramatic effect on its characteristics and performance. As a general rule, developers that are more dilute produce negatives with softer tonal gradations and finer grain. Diluted developers are ideal for Contraction developments because of their relatively longer development times and because of the compensating effect (see Appendix N). In general, you cannot reuse diluted developers, and you may notice some loss of effective film speed, causing you to use a lower ASA.

Negatives developed in more concentrated "high-energy" developers tend to have greater tonal separations and coarser grain. Concentrated developers are recommended for Expansions because their Normal Development Times are relatively short. These developers will generally allow you to use a higher ASA for a given film than developers that are less energetic.

Developers containing high concentrations of sodium sulfite (D76, XTOL, Perceptol, and ID-11) produce finer grain when used in their undiluted form. In high enough concentrations, sodium sulfite will act as a silver solvent and reduce graininess at the expense of image resolution.

Appendix **N**

Compensating Developers

Compensating developers are very dilute, slow-working developers that take advantage of the fact that denser areas of the negative (the highlights) exhaust developer at a faster rate than thinner areas. The reason is that the highlight areas contain more exposed silver.

As the film develops, residual byproducts (bromide ions) produced in the emulsion weaken the effect of the developer and slow the process. The function of agitation is to replace the weakened developer with fresh supplies. When the film is at rest between agitations in a compensating developer, the bromide ions build up at a much faster rate in the highlight densities of the emulsion than they do in the less dense shadow areas. This effect is exaggerated because a compensating developer is relatively dilute and therefore is less able to replace the exhausted developer saturated in the emulsion. This causes the highlights to increase in density at a much slower rate than the shadow areas. The shadows, in effect, are given a chance to increase in density, resulting in an overall decrease in contrast and better shadow detail.

Compensating Formulas

The following is a list of some popular compensating developers. (See Appendix W for references to other developer formulas.) You should conduct your own tests with these developers to discover the correct times for your film.

KODAK HC110

HC110 functions as a compensating developer when it is diluted 1:30 (from stock not the syrup). Average Normal Development Time: 25 minutes.

KODAK D-23

If you're ambitious and have a decent scale for weighing chemistry, Kodak D-23 is a formula you can mix yourself. The ingredients are available from any chemical supply company or from Photographer's Formulary (see Appendix W). Follow the formula for D-23 carefully and mix the ingredients in the order given.

KODAK D-23

WATER (125°F)	750 ML
Metol	7.5 g
Sodium sulfite	100 g
Water to make	1000 ml

The working temperature of D-23 is 68 degrees.

Two-Bath Compensating Formula

The Two-Bath method was made popular by Ansel Adams for extreme Contractions. It utilizes Kodak's D-23 formula listed above as part A, and the following formula as part B.

TWO-BATH FORMULA: PART B

WATER (125°F)	100 ML
Borax (granular)	20 g
Water to make	1000 ml

The working temperature is 68 degrees.

The procedure for using this Two-Bath formula is as follows:

1. Agitate the film continuously for four minutes in part A (D-23).
2. Move your film to part B and let it rest there, without agitation, for three minutes.

The result of the Two-Bath method should be contrast reduction equal to approximately N – 2. Two-Bath developer processes work because of the compensating effect described previously. A classic variation of this procedure is the water bath development process.

Water Bath Development

The water bath development technique was designed to dramatically reduce negative contrast with a minimal loss of shadow detail. It works best with sheet films because it assumes that there will be enough developer saturated into the shadow areas of the emulsion to allow them to continue developing after the highlight areas have exhausted their developer.

It should be noted that, in an effort to improve sharpness and reduce grain, film manufacturers have reduced the thickness of most modern 35mm film emulsions to a point where water bath development no longer works as well as it once did with roll film.

The basic technique for water bath development is as follows:

1. Agitate your film in the developer bath continuously for 30 seconds.
2. Quickly transfer the film without draining it to a bath of water and let it sit without agitation for one minute.
3. Repeat these steps three times and then process, wash, and dry your film normally.

Any standard developer will work with this process, but see the website:

www.digitaltruth.com/products/formulary_tech/01–0190.pdf

for information on the use of this technique with Amidol, one of the classic developers from the era of Edward Weston.

Appendix O

Inspection Development

The classic technique known as "inspection development" allows you to examine film for a few seconds while it is developing using a very dark green Kodak Safelight filter 3. The purpose is to give photographers an empirical method of determining when the negative's highlights are developed to the proper density. The film has to be at least two-thirds developed before you can safely turn on the light without danger of fogging the film. Read the directions that come with the filter very carefully.

Developing by inspection can be a useful technique to learn, but mastering it takes a considerable amount of practice. Modern films have thin emulsions and antihalation dyes in the backing, making it difficult to see more than dark shapes in the short time allowed.

Appendix **P**

Condenser and Diffusion Enlargers

The function of an enlarging light source is to provide enough light to cast the shadow of the negative onto the printing paper. Condenser and diffusion enlargers differ in terms of the quantity and quality of the light they present to the negative.

The light from a condenser enlarger is usually provided by a tungsten bulb. The light from this bulb is focused on the negative through a series of large lenses called "condensers." This focused light strikes the film in very straight, or collimated, rays.

The effect of a diffusion enlarger is much different. The light source is usually a fluorescent tube patterned into a grid. These tubes give off very little heat and thus are nicknamed "cold lights." The light from this grid is diffused through a piece of translucent glass or plastic so that the light striking the negative is scattered as much as possible.

When light passes through a negative, it is scattered by the density of silver in the emulsion. The greater the density, the more the light is scattered. This is called the "Callier effect." Collimated light from a condenser enlarger exaggerates this effect, giving the print more overall contrast and greater tonal separation. Because diffusion enlargers scatter the light more evenly across the surface of the emulsion, they render the true contrast of the negative more faithfully.

The advantages and disadvantages of condenser versus diffusion light sources can be summarized as follows:

- **Condenser enlargers.** The more a negative is enlarged, the more contrast is lost due to the scattering of light between the enlarging lens and the printing paper. Condenser enlargers compensate for this to a certain extent, which makes them very useful for printing small negatives, but there is a noticeable loss of tonal gradations, especially in the highlight areas of the print. Grain and dust are also more apparent with condenser enlargers. The extra contrast you can expect from condenser-enlarging light sources means that your Normal Development Times will be shorter when compared to

photographers printing with diffusion enlargers. It usually requires approximately 15 percent less development to compensate for this factor.

- **Diffusion enlargers.** As a rule, diffusion enlargers require that you produce negatives with more contrast than if you were printing with a condenser enlarger. This means that your Normal Development Time is likely to be longer. These enlargers are also dimmer and thus require slightly longer printing times. On the other hand, diffusion light sources render much more subtle tonal gradations in the highlights and obscure dust and scratches. This makes them ideal for printing medium- or large-format negatives. Add 15 percent to your Normal Development Times if you switch from printing with a condenser enlarger.

As of this writing, Aristo Archive Lamps from Light Tech Light Sources are a good supplier of cold light heads.

Appendix **Q**

ASA/ISO Numbers

Four interrelated numbering systems are commonly used to rate the speed of various films. The numbering can be confusing if you don't understand how the numbers correlate with one another, but the system is really very simple.

- **ASA** numbers increase geometrically as the film speed increases. As the speed doubles, the ASA number also doubles. When compared to a film rated ASA 200, a film rated ASA 400 requires one-half the exposure (one f/stop less exposure) to produce a given density. Because of this logical relationship, and because ASA is still in common usage, I use ASA numbers as a reference for film speed throughout this book. ASA stands for the American Standards Association, now known as the American National Standards Institute.
- **DIN** numbers are the European standard for film-speed rating. DIN numbers progress logarithmically. As the film speed doubles, the DIN number increases by three.
- **ISO** numbers combine ASA and DIN into one number. For example, Tri-X is rated ASA 400, DIN 27, and ISO 400/27.
- **EI** stands for Exposure Index. These numbers are used in the same way as ASA numbers but indicate that the user determined the film speed through a testing procedure.

Appendix **R**

Filter Factors, the Reciprocity Effect, and Bellows Extension Factors

Filter factors, the reciprocity effect, and bellows extension factors greatly affect your exposure.

Filter Factors

Colored filters are useful for increasing the contrast between objects that are different colors. A filter will transmit its own color and absorb its complementary color. Thus, a red filter will lighten a red apple when used with black-and-white film and darken a blue sky. Filters can produce important effects, but you need to remember that the filter is blocking some of the light that would otherwise be exposing the film. Unless you compensate for this lost light, the negative will be underexposed. Every filter is associated with a number called a **"filter factor."** This number indicates how much exposure to add for each filter. For example, if the factor for a given filter is 2, the exposure must be increased by two times to get the proper exposure. Because each f/stop doubles the exposure as it opens up, a filter factor of 2 requires opening up one stop. A filter factor of 4 would require a two-stop adjustment. Because daylight has a bluish cast and tungsten light is reddish, the filter factors for daylight are slightly higher. (The one exception is a dark blue filter, #47, which has a higher tungsten filter factor number.) Filter factors are listed in the Kodak data guides for filters and black-and-white films.

The Reciprocity Effect

Ordinarily, f/stops and shutter speeds have an equal effect on exposure. Changing the f/stop from f/8 to f/11 is equivalent to changing the shutter speed from 1/60 to 1/125 of a second. In either case, the exposure is one stop less. The reason is that f/stops and shutter speeds are calibrated to be equivalent, or "reciprocal." Unfortunately, this is true only within a certain

range of exposure times (camera shutter speeds). If your exposure is longer than 1/2 of a second or shorter than 1/1000 of a second, the reciprocity rule "fails."

For example, a negative exposed for 1/2 of a second at f/2.8 will give lower densities than one exposed for 4 seconds at f/8. The film will be underexposed even though, according to your light meter, these two exposures should be the same. This is called **"reciprocity failure."** Assuming that you need to use f/8 for depth of field, the solution would be to use an exposure of f/8 at 15–20 seconds. If this sounds imprecise, you will find that published reciprocity charts are very general. You also need to compensate for the increase in contrast that results from such long exposures. Ten to 30 percent less development will be required for negatives that have been exposed for longer than 1/2 of a second.

Because of their unique grain structure, Kodak TMax films require less compensation for the reciprocity effect than conventional films. As stated previously, with standard grain films, when your indicated exposure is 10 seconds, a 50-second exposure is required, with a 20 percent reduction in your development time to avoid underexposure and overdevelopment. With TMax, Kodak recommends an exposure of only 15 seconds for a 10-second indicated exposure with no reduction of your development time. Standard reciprocity failure charts apply to Ilford's Delta films.

For more information on the reciprocity effect, consult *Kodak Professional Black-and-White Films* data book or *Basic Photographic Materials and Processes* published by Focal Press.

Bellows Extension Factors

To focus on an object very close to the lens, you need to increase the distance between the lens and the film. This is important to know because if the film–lens distance becomes greater than the focal length of the lens, the f/stop numbers become inaccurate.

An interesting way to visualize why this happens is to imagine that you're inside a large camera that is focused on an object approaching the lens. If the lens is set at f/11, as the lens gets farther away from the film, the size of aperture f/11 will appear to decrease. Eventually, f/11 will appear to be the size of f/22 from the film's point of view. The rule is: As the lens-to-film distance increases, the effect of a given f/stop will decrease. Unless you compensate for this, the negative will be underexposed when you use extension tubes on a 35mm camera or extend the bellows of a view camera beyond the focal length of the lens.

The bellows extension factor tells you how much exposure to add to get good results when doing close-up photography. There is a mathematical formula that you can use to compute this factor, but an easier way to figure it out is to use one of the many handy devices that have been developed especially for this purpose. Two examples are the Quick Stick, manufactured by Visual Departures in New York, and the Calumet Exposure Calculator.

Appendix **S**

A Compensation Method for Inaccurate Meters

Light-meter accuracy and consistency are essential for good results. Many large camera stores and repair shops will run a simple "known light source" test on your meter for a small charge. If the test indicates that your meter is reading one-half to one stop under or over normal and can't be adjusted for some reason, you can compensate for this by using an alternative ASA number. For example, if the meter is supposed to read f/5.6 at 1/125 set at ASA 400, but instead reads f/4 at 1/125, simply reset the ASA to 800. The meter will now register accurate exposures, and from now on, ASA 800 will represent ASA 400 when that meter is used. To help you remember to double the ASA, tape a reminder to the outside of the meter.

This method will work if the meter is inaccurate by the same amount throughout the scale. If it's off by different amounts on the high and low ends of its range, leave it at the repair shop.

Appendix **T**

Zone System Metering Form: In-Camera Meters

The following steps describe a simple method for measuring contrast and determining the proper exposure for a subject using built-in camera meters.

[**note**] This form can also be used to simplify the process of applying the Zone System to complex lighting studio setups as described in Chapter 11.

1. First, previsualize the Important Shadow (usually Zone III) and the Important Highlight (usually Zone VII) areas of your subject.
2. Meter both of these areas using either an aperture or a shutter speed as a reference. For example, your two meter readings might be

   Important Shadow area ..... 1/30 at f/5.6
   Important Highlight area ..... 1/30 at f/22

In this example, the shutter speed of 1/30 is your reference reading; the two apertures are your measurement readings.

3. Write your reference reading in the box provided for that purpose near the bottom of the form.
4. Write the shadow measurement reading under the Zone III (or II) box and fill in the other readings under the corresponding zones where they automatically fall after the shadow reading is placed where you want it to be.

For example: If you write the f/5.6 measurement reading on Zone III, f/8 will fall on Zone IV, and f/11 on Zone V, and so on.

5. If the measurement reading for your important highlight falls on the zone you previsualized for it (usually Zone VII), use Normal Development.

If it falls one zone too high, use N – 1. If it is one zone too low, use N + 1, and so on.

6. The measurement reading that falls on Zone V, plus the reference reading, is the correct exposure for that placement.

In this example, the correct exposure would be **f/11 at 1/30;** or an equivalent exposure like **f/5.6 at 1/125.**

See Figure T1 overleaf.

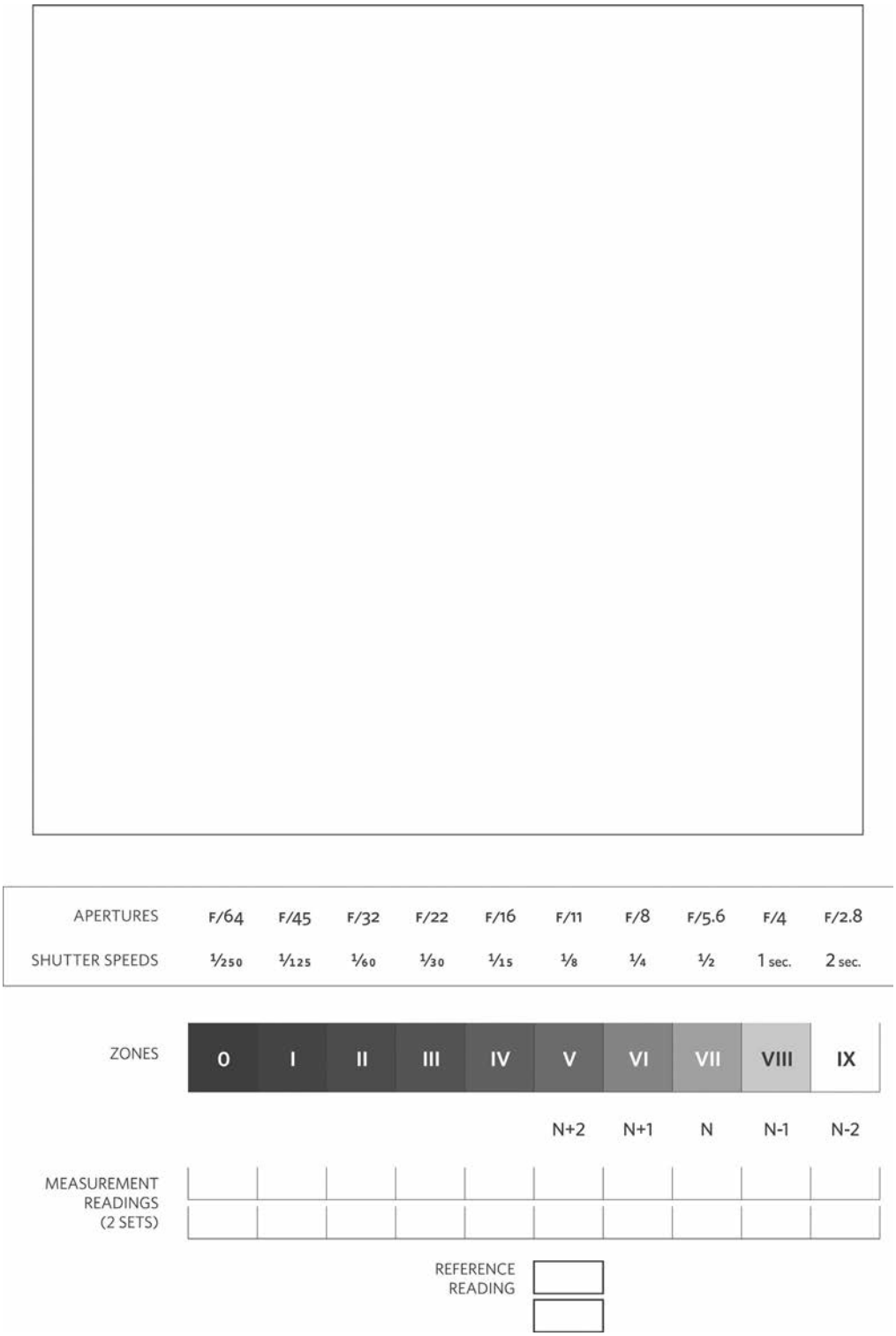

APERTURES
F/64 F/45 F/32 F/22 F/16 F/11 F/8 F/5.6 F/4 F/2.8
SHUTTER SPEEDS
1/250 1/125 1/60 1/30 1/15 1/8 1/4 1/2 1 sec. 2 sec.
ZONES
0 I II III IV V VI VII VIII IX
N+2 N+1 N N-1 N-2
MEASUREMENT READINGS (2 SETS)
REFERENCE READING

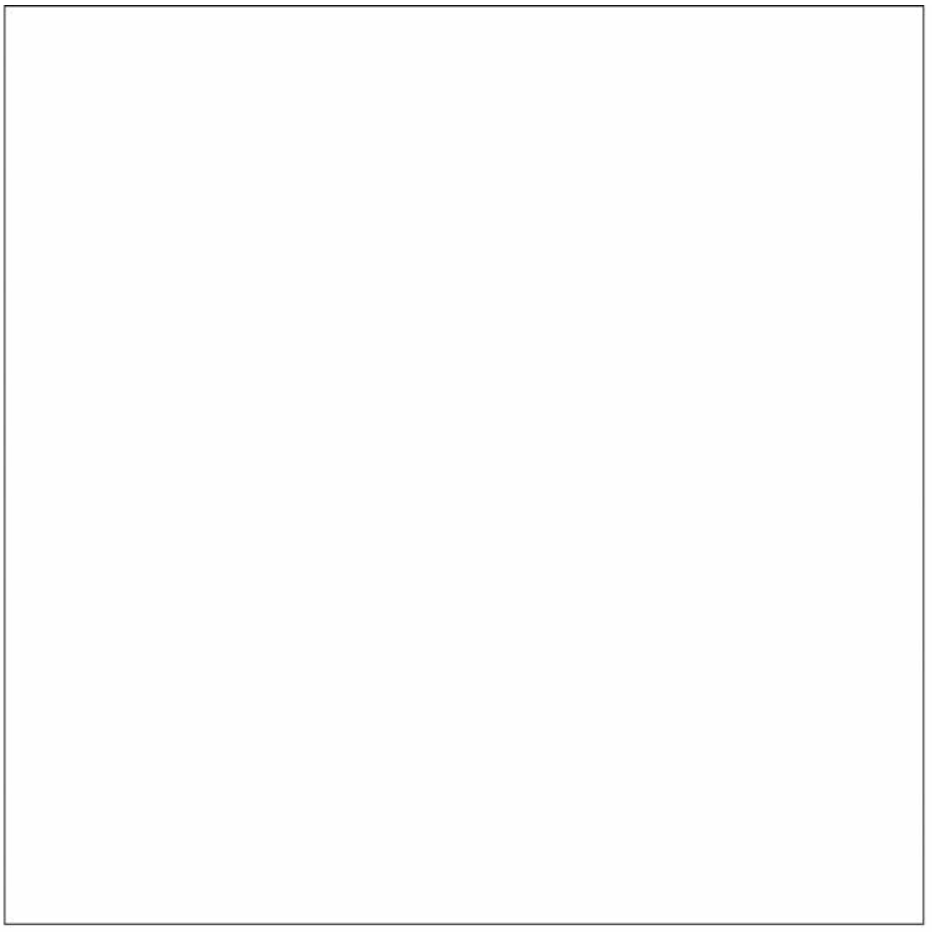
FIGURE T.1 Metering form example.

FIGURE T.1 continued

Appendix U

Exposure Record and Checklist for Zone System Testing

(See the following pages.)



EXPOSURE RECORD

FILM: _____

		ZONES									A	B	C	
SUBJECT	0	I	II	III	IV	V	VI	VII	VIII	IX	S SPEED	F STOP	ASA	DEV
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

Instructions for sheet film are included after the regular instructions. Check off each step as you proceed through the test.

MATERIALS

- ☐ Camera
- ☐ 4 rolls of film
- ☐ Developer
- ☐ Tripod
- ☐ Paper (your normal grade and size)
- ☐ Neutral Gray Card
- ☐ Reflected-light meter
- ☐ Cable release

MATERIALS FOR SHEET FILM

- ☐ Developer
- ☐ 24 sheets of film
- ☐ 12 film holders
- ☐ Large notepad
- ☐ Marker

STEPS

☐ **Step 1** Draw your test subject above the Exposure Record.

☐ **Step 2** Meter your Zone II, III, V, VII, and VIII areas and fill in these values on your sketch.

☐ **Step 3** Enter your readings on the Exposure Record. Place the Important Shadow area on Zone III. Does the Zone VII reading fall on Zone VII?

- ☐ Yes (go to next step)
- ☐ No (find another subject)

☐ **Step 4** Set up camera. Put a Neutral Gray Card in the image area. Does the Neutral Gray Card reading fall on Zone V?

- ☐ Yes (go to next step)
- ☐ No (move the card)

☐ **Step 5** Calculate your exposures and fill in the Exposure Record with the appropriate readings.

- ☐ Plan A (roll film)
- ☐ Plan B (sheet film)

☐ **Step 6** Recheck your meter readings. Have they changed?

- ☐ Yes (go back to step 2)
- ☐ No (go to the next step)

ROLL FILM (ALTERNATIVE A)

☐ **Step 7**

- ☐ a. Expose one roll using the exposures noted on the Exposure Record.
- ☐ b. Recheck the meter readings and expose rolls 2, 3, and 4 using the same exposures.

SHEET FILM (ALTERNATIVE B)

☐ **Step 7**

- ☐ a. Place the notepad in the image.
- ☐ b. In large letters, write 1A on the pad.
- ☐ c. Expose the #1 sheets of sets A, B, C, and D using the #1 exposure noted on the Exposure Record.

Did you change the letter for each exposure?

- ☐ Yes (go to next step)

- ☐ d. Write 2A on the notepad.
- ☐ e. Expose the #2 sheets of sets A, B, C, and D using the #2 exposure noted on the Exposure Record.

Did you change the letter for each exposure?

- ☐ Yes (go to next step)

- ☐ Repeat the preceding procedure for sheets 3, 4, and 5.

Consult Chapter 8, "Zone System Testing: Method 1," for instructions to complete steps 8–12.

Appendix V

Examples: Zone System Applications

The idea for this appendix was inspired by my favorite Ansel Adams book, *Examples: The Making of 40 Photographs*. In this classic, Ansel describes in great detail, and with thoughtful autobiographical comments, how he created many of his greatest images. His book allows you to begin to understand the complexities of his creative process and the role the Zone System played in making his photography masterful.

Contrary to some misconceptions, the Zone System is an extremely versatile tool with applications in many areas of photographic practice. This appendix demonstrates how you can apply the Zone System to color, architectural, digital, studio, figurative, and documentary photography.

Six participating photographers were asked to describe in their own words how the Zone System contributed to the creation of their images. These statements represent very personal approaches and illustrate how, with experience, you can adapt the Zone System to a wide range of photographic problems.

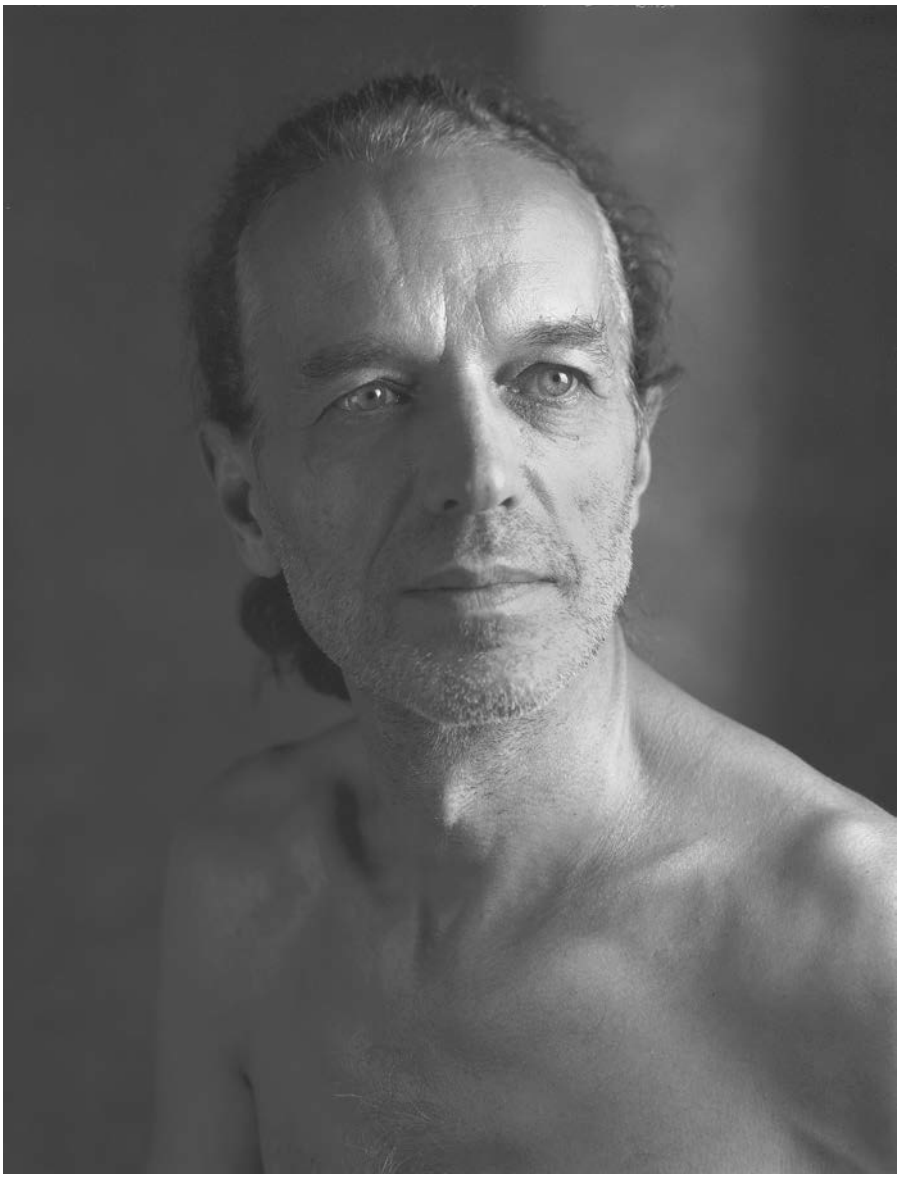
The common denominator in all these examples is *previsualization*. The ability to use the Zone Scale to form a mental image of your final print before taking the picture is a powerful creative advantage. After the image is previsualized, the problem of how to achieve the desired result depends on the nature of the shooting circumstances and your materials.

My example of photographing with portable strobes on a street corner in Oakland California demonstrates the Zone System's flexibility.

I would like to thank Christine Alicino, David Bayles, Dan Burkholder, Judy Dater, and Robert Bruce Langham III and the family of Wynn Bullock for their generosity and cooperation in preparing these examples.

Christine Alicino

This portrait was done for Rolf Engle's 60th birthday so I was looking for an image of him that was stately, sensitive, and conveyed his dignity and creativity.



Rolf Engle, 2002.

What I love about working with lights in the studio is that I can control the technical aspects of the process so that I can concentrate on the mood and presence of the subject.

This was especially important in this case because I was using Polaroid Type 55 film, which meant that the exposure and contrast needed to be perfect since there was no opportunity to change things after the fact.

I previsualized this portrait as having soft but dramatic contrast. The background needed to be dark but light enough to allow for separation with his hair (Zones III and IV). His skin needed to be luminous but detailed (Zones VI and VII).

Since the light source was a continuous, daylight balanced light with a Fresnel lens in a soft box, I used the distance between the subject and the background to control the shadow values and between the subject and the light source to control the highlights. I used an incident light meter to determine the exposure.

Christine Alicino is a freelance professional and fine art photographer who shoots people, products, editorial, and environmental photography in the San Francisco Bay Area (www.christinealicino.com).

LIGHT SOURCE: 1000 watt HMI in a soft box

FILM: Polaroid Type 55

ASA: 50

DEVELOPER: N/A

DEVELOPMENT: Normal

David Bayles

This photograph was made with a view camera in the early 1970s, under the influence of reading John Cage and of wondering about randomness. I deliberately sought randomly organized objects as subjects—among them scatterings of driftwood imbedded in wind-smoothed sand (see Figure 4.2) and jumbles of fallen flowers and leaves.

Untitled, 1970s.

But by November, fallen leaves are drab. The negative was developed about N + 2; even so, there was a need for considerable burning of the darker values and some holding back of the lighter ones, all on fairly contrasty paper.

There is a kind of picture that glows even though the range of tones is quite compact, deep, and relatively soft. While such pictures may be hard to print, the tonalities aren't really hard to previsualize. The harder part is the anticipation of what—if anything—is the real content.

David Bayles studied photography with Ansel Adams and, together with Ted Orland, is the author of *Art and Fear: Observations On the Perils (and Rewards) of Artmaking*. David's work has been widely exhibited. He lives and works in Eugene, Oregon.

Dan Burkholder

125th Street Station, New York City.

HDR IN THE LANDSCAPE

Looking over the way different people use the Zone System, I'm reminded of the fable of the blind men examining the elephant: The man feeling the elephant's leg says, "an elephant is like a tree," another man feeling the ear says, "an elephant is like a leaf" and on it goes. The range of Zone System interpretations really isn't very different.

There was a time in my own image making when I used the Zone System more traditionally. That was way back when I used a view camera and spot meter to place my shadows and measure highlights to determine times for film development. Times have changed for me and the way I make photographs. More than 12 years have passed since I exposed a sheet (or roll, or cassette,

Plant on Church Floor, New Orleans.

or disk—yes, at one time we had "disk" cameras, and I don't mean computer disks but round disks of film). Heck, at the moment, my camera of choice is an iPhone! These iPhone images are printed either as archival inkjet prints or as hand-coated platinum/palladium prints on a thin vellum paper behind which I apply 24K gold leaf. What hasn't changed over the decades is the need to make tonal decisions. Whereas we used to bend the tonal response of our materials chemically, we now do it by manipulating numbers in an image file.

HDR is simply the digital way of dealing with issues of high dynamic range in the scene. Instead of varying our exposure and film development, we supply several bracketed exposures that computer software (or iPhone apps!) can meld together, producing a final image with lush detail in all regions of the image.

It's important to emphasize that our 2011 HDR methods are merely a temporary fix—a somewhat klutzy workaround necessitated by our current breed of image sensors that don't have the dynamic range we want and need. But, fear not, in just a few years we'll have more dynamic range than we know what to do with. Whether it's because of sensor improvements or cameras that nearly instantaneously combine that bracketed series of captures, the days of manually shooting bracketed images and using special software will soon be behind us. But that's in the future. In the mean time, to paraphrase a former defense secretary, we go to HDR photography with the version of the sensor we have, not the version we'd like to have.

IMAGE INFORMATION

"125th Street Station, New York City" was an iPhone HDR image. An app provided a dark and light exposure that I combined with yet another app. There was additional stylizing with—you got it—more apps.

The "Plant on Church Floor, New Orleans" image is HDR, from about 10 bracketed exposures.

Dan Burkholder received his bachelor's and master's degrees in Photography from Brooks Institute of Photography in Santa Barbara, California. Dan's book *The Color of Loss* (University of Texas Press, 2008) graphically illustrated the destruction of New Orleans after Katrina and was the first book shot entirely with HDR techniques. His book *iPhone Artistry* (Pixiq Press, 2011) is the definitive resource for creative iPhone photographers.

Judy Dater

This photograph was taken very late in the afternoon after the sun had set. I was attracted to the strange and inexplicable white boulder sitting on the dark red-brown earth. I wanted to heighten the contrast of the white rock, rope, and figure against the dark ground. I metered the earth and placed it on Zone III. Then I metered the rock and found that I would have to develop the film at N + 2 to bring it up to Zone VII. This produced the desired effect.

Untitled, 1983.

Judy Dater is one of the best-known fine art photographers in the world. Her work has appeared in major museum exhibitions and photography publications, and she has been awarded the Dorothea Lange Award of the Oakland Museum and the Guggenheim Award for her outstanding contributions to photography. She is the author of *Women and Other Visions* with Jack Welpott (1975), and *Imogen Cunningham: A Portrait* (1979) and *Cycles* (1992).

FILM: Kodak Tri-X, 4 × 5

ASA: 200

DEVELOPER: Kodak HC-110, Dilution B

DEVELOPMENT TIME: 10 minutes

Chris Johnson

TYRONE BURNS

This portrait was done for the Oakland Fence Project, an interactive community arts project devoted to honoring local heroes in Oakland neighborhoods. I shot this in the late afternoon using a Phase One P40+ digital back and portable strobe units with four heads to light Tyrone and the barbershop behind him.

Tyrone Burns, Owner—Pull Up Your Pants Barbershop, 2016

In Chapter 11, "The Zone System and Studio Photography," I explain how, after you determine your Key Aperture that provides the depth of field you need for a given image, you can use incident flash meter aperture readings to produce the lighting effects you need.

For example, the readings for his face were f/11 for the key light on the bright side of his face and f/8 for the darker side. The two strobes lighting the building behind him were set to watt second powers and distances that resulted in readings of f/8. (Review Chapter 11 if this is not clear.)

An important aesthetic consideration when shooting outdoors with strobes is how your choice of shutter speeds affects the ambient light. A normal exposure for this scene would have been f/11 at 1/30. Instead I used f/11 at 1/60 to darken the overall ambient lighting.

Another exciting element of this project is that I created a short video of Tyrone explaining why he calls his barbershop Pull Up Your Pants.

To see this video use the following steps:

1. Go to the Apple App Store and download the Oakland Fence Project mobile app to your iPhone.
2. Once the app loads, open it and dismiss the Welcome Screen.
3. Aim the camera frame at my portrait of Tyrone on these pages and the video will automatically begin to play. This effect is called augmented reality art.

CAMERA: Mamiya 645DF+ Medium Format DSLR Camera with 80mm f/2.8 LS Lens and Phase One P40+ digital back

CHRISTINE ON TOMALES BAY, 2005

This moment presented itself to be photographed early one morning in Northern California. The camera I used was a Nikon D70 digital camera set to raw format at ISO 200.

Christine on Tomales Bay, 2005.

To avoid digital noise in the subtle darker areas, I biased the exposure toward the soft glow of the highlights as described in the section of Chapter 10 titled "The Zone System of Digital Exposure: Exposing for the Highlights."

The initial tonal adjustments were done with Adobe's Camera Raw Utility. The file was sharpened with PhotoKit Capture Sharpener, and the final color corrections were made with Photoshop's Levels command.

I printed this image on Hahnemühle Photo Rag paper with an Epson 4900 inkjet printer.

Robert Bruce Langham III

I was up against the east wall of the volcanic neck, just above a popular pull-up spot. Very rugged to move about. I could see the weather change coming from the west. My meter was a Pentax Spot with a Zone VI scale pasted on the dial. I kept checking the contrast between the big shadow and the sunlit area. Didn't want to lose either, and they never threatened the range of the film beyond what you might expect. If forced to choose, I was going to give up shadow to get highlights. The light changed rapidly in quantity out on the plains while the shadow held steady. Never got contrasty beyond reason.

I started shooting my few sheets of film wondering how much better or worse it was going to get. Exposures ran around 1/2 second at 22 with a polarizer. Driving rainstorm ran me into the truck as the light turned flat. I sat and reloaded my holders anticipating better light after it lifted, but it just got dark.

East Dike, Summer Storm, Shiprock, New Mexico, 2004.

Robert Bruce Langham III is a photographer and writer who lives and works very well, right where he was born in Tyler, East Texas.

IMAGE INFORMATION

CAMERA: 5X7 Deardorff with a Fuji 120 lens

FILM: Kodak Tri-X sheet film (before they changed the coating process)

EXPOSURE: f/32 (or so) at several seconds

DEVELOPER: Kodak HC-110 (B)

DEVELOPMENT: Normal Minus 3

PRINT: Ilford Multigrade Warmtone with Ilford Harmon Warmtone developer

Easy print without much dodging or burning.

Wynn Bullock

This remarkable image has been known as “Let There Be Light” since 1955 when Edward Steichen paired it with the famous biblical quote for his seminal “The Family of Man” exhibition at the Museum of Modern Art in New York. When this exhibition opened at the Corcoran Gallery in Washington, DC, “Let There Be Light” was voted the most popular image in the show.

At first glance most people assume that this image depicts moonlight over the ocean at night but, in fact, Wynn Bullock used an 8 x 10 view camera to make this exposure as the sun was setting over a fully lit beach in Big Sur, California.

The dramatic difference between Bullock’s creative vision of this moment, and the way it would have looked in a normal rendering is a perfect example of applied photographic technique. The results are inspiring!

Here is the way that Wynn Bullock has written about the way he photographed:

> From the beginning I have placed great emphasis on the fact that darkroom work is an important element in the creative photographic process. When photographing I become so involved in what I'm perceiving that I have to force myself to think of technique. I use a Weston meter, take a high and low reading, and bracket my exposures. My negatives aren't always what they should be, but that's the way it is.

Wynn Bullock was a master printer and heavily manipulated his prints in the darkroom. The basic exposure used to create "Let There Be Light" would normally be considered drastically underexposed were it not for the fact that achieving a powerful contrast between the deep blacks of the beach and the luminous stream of water were clearly his intentions.

Wynn Bullock (April 18, 1902–November 16, 1975) is one of the master photographers of the twentieth century whose work is included in over 90 major museum collections around the world. During his lifetime he published numerous books and is acclaimed in all of the standard histories of modern photography. In addition to numerous bodies of complex and beautiful work, Bullock also thought deeply about the nature of human perception, the underlying nature of reality and human perception.

CAMERA: 8 × 10 Ansco View Camera

FILM: Ansco Isopan

DEVELOPER: Pyro ABC Developer

DEVELOPMENT: Hand developed by inspection

PRINT: Kodak Polycontrast or Agfa Brovia in Amidol developer

Appendix **W**

Suggested Reading

Film Photography

Black and White Photography: A Basic Manual (3rd ed.) unabridged
Henry Horenstein
Little, Brown and Company

Photography
Barbara London, Jim Stone, and John Upton
Prentice Hall

The Ansel Adams Photography Series (10th ed.)
Ansel Adams
Little, Brown and Company

Digital Photography

Adobe Master Class: Photoshop Inspiring artwork and tutorials by established and emerging artists
Ibarionex Perello
Adobe Press

Digital Negatives: Using Photoshop to Create Digital Negatives for Silver and Alternative Process Printing
Brad Hinkel and Ron Reeder
Taylor & Francis

Photoshop Masking & Compositing
Katrin Eismann, Sean Duggan, James Porto
Peachpit Press

Real World Digital Photography
Katrin Eismann and Sean Duggan
Peachpit Press

The Digital Negative: Raw Image Processing in Lightroom, Camera Raw, and Photoshop
Jeff Schewe
Peachpit Press

The Digital Photography Book Series
Scott Kelby
Peachpit Press

The Digital Print: Preparing Images in Lightroom and Photoshop for Printing
Jeff Schewe
Peachpit Press

The HDR Book: Unlocking the Pros' Hottest Post-Processing Techniques
Rafael Concepcion
Peachpit Press

Real World Color Management
Bruce Fraser, Chris Murphy, Fred Bunting
Peachpit Press

Stephen Johnson on Digital Photography
Stephen Johnson
O'Reilly Media, Incorporated

Technical Resource Books

Basic Photographic Materials and Processes
Ira Current, John Compton, Leslie Stroebel, Richard D. Zakia
Taylor & Francis

Focal Encyclopedia of Photography
Richard D. Zakia, Leslie Stroebel
Taylor & Francis

Creativity and Ideas

Art & Fear: Observations on the Perils (and Rewards) of Artmaking
David Bayles and Ted Orland
Image Continuum Press

Camera Lucida: Reflections on Photography
Roland Barthes
Farrar, Straus and Giroux

Looking at Photographs: 100 Pictures from the Collection of The Museum of Modern Art
John Szarkowski
Museum of Modern Art

On Photography
Susan Sontag
Picador

The Daybooks Of Edward Weston
Edward Weston
Aperture Foundation

The Digital Evolution: Visual Communication in the Electronic Age: Essays, Lectures and Interviews, 1967–1998
A. D. Coleman
Nazraeli Press

Ways of Seeing: Based on the BBC Television Series
John Berger
Penguin Publishing Group

Appendix X

A Brief Directory of Online Digital and Photography-Related Resources

The Internet has become a vast and prime source of free information about digital and film photography, and also a venue for the display of creative photo-related artwork. This appendix makes no attempt to provide a comprehensive listing of available resources. The following are some of my personal bookmarks that I've found useful or interesting. Also remember that the Internet is a volatile place, so some of the sites listed may have moved or been discontinued by the time you read this.

Some Digital Technical Reference Sites

Adobe's Resource Center
Adobe's site for creative projects, ideas and techniques
http://create.adobe.com/photography.html

Adobe's White Papers and Tips on Digital Photography
Adobe's site for tutorials, projects and articles
https://helpx.adobe.com/photoshop.html

John Paul Caponigro
A talented photographer whose site contains many useful links
www.johnpaulcaponigro.com

Computer-Darkroom
Feature articles, tutorials, reviews and technical discussions relating to digital image processing
www.computer-darkroom.com

Dante Stella
Some personal and satirical comments on technique
www.dantestella.com/technical.html

Earthbound Light
A great source of digital imaging tips and technical information
www.earthboundlight.com/phototip-archives.html

ShortCourses.com_The On-line Library of Digital Photography
Short tutorials on digital photography
www.shortcourses.com

Layers Magazine
Layers Magazine's site for useful tips and ideas
http://layersmagazine.com

Luminous Landscape
A great place to find clear tutorials on digital and film-based photography
https://luminous-landscape.com

Norman Koren.com
A great place to find highly technical information regarding light and color
www.normankoren.com/light_color.html

Photoshop News
A site for daily news about Photoshop and other digital photographic issues
www.photoshopnews.com

Russell Brown's Tutorials
An original Adobe Photoshop genius offers great information and essential tools
www.photoshop.com/people/russell

Digital Photography Resources

Chromix
Tools and software for all your color management needs
www.chromix.com

Digital Art Supplies
A comprehensive resource for digital printing supplies
www.digitalartsupplies.com

Digital Camera Reviews
www.dpreview.com

Lexjet
One of the best sources of digital printing supplies and software
www.lexjet.com

Photoshop-Related Applications

Photo Ninja
Integrated suite of state-of-the-art enhancement and correction tools
www.picturecode.com/

Pixel Genius
Sophisticated plug-ins for Photoshop sharpening and other effects
www.pixelgenius.com/

General Photography Sites

Digital Truth
A vast compilation of manufacturer-recommended development times for every imaginable film
www.digitaltruth.com/

The Photographer's Formulary
A great source for specialized photo chemistry and information
www.photoformulary.com

Photo.Net
A site for general resources, essays, and equipment
http://photo.net/photo/

Some Virtual Galleries and Museums

After Image Gallery
One of the oldest fine art photo galleries in the country
www.afterimagegallery.com/

The Ansel Adams Gallery
The website of the famous gallery and bookstore in Yosemite Valley
www.anseladams.com/

Aperture Gallery
www.aperture.org/

California Museum of Photography
www.cmp.ucr.edu/

Camera Obscura
Vintage and contemporary photography
http://thor.he.net/~matheny/

Center for Creative Photography
A major museum and research center
http://dizzy.library.arizona.edu/branches/ccp/ccphome.html

Center for Exploratory and Perceptual Art
http://cepagallery.com/

Center for Photographic Art
The site of one of the shrines of photography in Carmel, California
www.photography.org/

The Center for Photography at Woodstock
A nonprofit gallery and workshop organization for fine art photography
www.cpw.org/

SF Camerawork
www.sfcamerawork.org/

Dom Fotografie/House of Photography
Fine Eastern European photography
www.domfoto.sk/anglicka/newsletter/newsletter_e.htm

Equivalence: European Photography
equivalence.com/

The George Eastman House
www.eastman.org/

Charles Guice Fine Art Photography
Specializing in the artwork of black photographers
www.charlesguice.com/

The History of Photography
www.rleggat.com/photohistory/index.html

Houston Center of Photography
www.hcponline.org/

The Image Works
An important editorial and commercial stock agency
www.theimageworks.com/

The International Center of Photography
A major center of documentary and fine art photography
www.icp.org/

La Maison Europeenne de la Photographie
A center for European Photographic arts
www.mep-fr.org/us/default_test_ok.htm

Museum of Photographic Arts
One of the most creative photo institutions in the world
www.mopa.org/

The Photographer's Gallery
A gallery of emerging photo-artists based in London
www.photonet.org.uk/

The Photographic Resource Center
A forum for the exploration, interpretation, and celebration of new work, ideas, and methods in photography
www.bu.edu/prc/

Photographs Do Not Bend Gallery in Dallas
www.photographsdonotbend.com/

The Southeast Museum of Photography at Daytona Beach Community College
An innovative gallery of fine art photography
www.smponline.org/

Documentary Photography Sites

Agence VU
An international photo agency and gallery of photographers and stories
www.agencevu.com/fr/visa2005/index.html

The Digital Journalist
Workshops, news and archives of digital photo journalists
digitaljournalist.org/

Magnum Photos
An international photographic cooperative owned by its photographer-members and home to legendary documentary photographers
www.magnuminmotion.com/

The Life Picture Collection
The best of the Time Life archives
www.timelifepictures.com/ms_timepix/source/home/home.aspx?pg=1

War Shooter
A portal for photojournalists covering conflict, crisis and disaster
warshooter.com/

VII Photo Agency
A site devoted to the genre of concerned photography
www.viiphoto.com/

Some Other Art-Related Photography Sites

LensWork Quarterly
Features a gallery, essays, and interviews
www.lenswork.com/

Society of Photographic Educators
www.spenational.org/portfolio/index.html

The Light Factory
A site for innovative creative projects
www.lightfactory.org/

The Manchester Craftsmen's Guild
William E. Strickland's center of art and community service
http://mcgyouthandarts.org/

The Nearby Cafe
A gathering place for artists, creative projects, organizations, and other cyber-cultural activities
www.nearbycafe.com/

The Visual Studies Workshop
Visual Studies Workshop's mission is to support makers and interpreters of images through education, publications, exhibitions, and collections
www.vsw.org/

Zone Zero Gallery
A very sophisticated site featuring a gallery, bookstore, and forum
www.zonezero.com/

Photo-Artist Sites

Christine Alicino
www.christinealicino.com

Wynn Bullock
Home site of one of the most profound artists of our time; and one of my mentors
www.wynnbullockphotography.com

Dan Burkholder
A talented and innovative artist
www.danburkholder.com/

Chris Johnson
www.chrisjohnsonphotographer.com

To Save a Life, Stories of Jewish Rescue
Ellen Landweber's labor of love
www.humboldt.edu/rescuers/

Sally Mann
Photographer and author of the highest order
http://sallymann.com

Mary Ellen Mark
www.maryellenmark.com

Jim Marshall Photography
Personal site of the legendary photographer of early rock music
www.marshallphoto.com/

Susan Meisilas
A preeminent artist committed to creativity and justice
www.susanmeiselas.com/

Julio Mitchel
This site will introduce you to many bodies of work by this great documentary photo-artist
www.juliomitchel.com/

Eugene Richards
Influential photographer, writer, and filmmaker
www.eugenerichards.com/

Sebastiao Salgado
One of the world's great documentary photographers
www.amazonasimages.com/

Lonny Shavelson
Photojournalist, writer, radio and multimedia journalist
www.photowords.com/index.php

Elisabeth Sunday
She travels the world producing beautiful and unique bodies of work
http://elisabethsunday.blogspot.com

Larry Sultan
A gifted artist and educator with many influential bodies of work
http://larrysultan.com

Virtual Magazines and Journals

ArtBook
A comprehensive catalog of photography art books in print
www.artbook.com/catalog—photography—monographs.html

Photo-Eye Books and Prints
An online photography bookstore and index
www.photoeye.com/

The Photo Review
A journal, gallery, and photography-related newsletter
www.photoreview.org/

Appendix **Y**

A Brief Glossary of Zone System and Digital Terminology

Acutance The term used to describe the degree to which a negative renders a sharp distinction between adjacent print tones. Acutance is related to negative contrast and shouldn't be confused with image sharpness or resolution. Dilute developers and long development times will increase acutance.

Banding In a digital image, banding appears as distinct tonal steps where there should be a smooth continuous gradation. This is generally considered to be a problem that is caused by the loss of pixel levels when the image is edited in one of Adobe Photoshop's contrast adjustment tools such as the Levels or Curves command. "Posterization" is another word commonly used to describe this effect.

Bit Depth A pixel's bit depth is a measure of the number of individual tones of gray or color a pixel is allowed to be in an image, measured in bits of digital memory.

Bitmapped A bitmapped digital image is one composed of numerous individual tile-like picture elements known as "pixels." Bitmapped images are said to be rasterized as opposed to vector-based images, which are constructed from mathematically defined shapes and lines.

Bracketing After using a light meter to determine the "correct" f/stop and shutter speed for a given photograph, you would use bracketing to give the film more or less than this base exposure to achieve the desired result. Bracketing is usually done by adjusting the aperture.

Charge Coupled Device (CCD) One of the two main types of image sensors used in digital cameras.

Clipping In digital photography, a light or dark tonal value is said to be clipped when too much inherent contrast or a Photoshop tonal adjustment pushes that value beyond the range of values that can be rendered.

CMOS (Complementary Metal-Oxide Semiconductor) One of the two main types of image sensors used in digital cameras.

Color Management The calibration, profiling, and coordination of all elements in a digital imaging workflow for the purpose of ensuring that the final print or other output matches the image represented on the computer monitor as closely as possible.

Colorsync A color management system introduced by Apple Computer Co.

Contraction The decrease in negative contrast brought about by using a development time that is less than Normal Development. Contraction is symbolized by N–, followed by the number of zones by which you want to decrease the contrast. For example, N – 2 represents a decrease of your development time, below Normal Development, that is enough to reduce a Zone IX negative density to a density equivalent to Zone VII. Contraction is also known as "compaction."

Contrast

1. **Subject Contrast** refers to the relative difference between the amount of light reflected by the "highlights," or bright areas, of the subject and the "shadows," or darker areas. This difference is measured with a reflected-light meter.
2. **Negative Contrast** refers to the relative difference between the "shadow," or thinner, areas of the negative and the "highlight," or more dense, areas.
3. **Print Contrast** (also called "tonal separation") is the ability of the film and printing paper to render a visual distinction between close tonal values. Print contrast increases when a negative is printed on higher grades of paper.

Density "Density" is a technical term used to indicate the relative opacity of a negative as measured with a densitometer. The term is commonly understood to mean the relative thickness of silver in the negative.

DPI (dots per inch) A measurement of the resolution of a digital photo or digital device, including digital cameras and printers. The higher the number, the greater the resolution.

Drivers Software associated with digital scanners and printers that controls the functioning and coordination of the device with all other elements of the workflow.

Dynamic Range The term used to define the total range of tonal values, or levels in a digital image. Also referred to as "contrast."

Expansion The increase in negative density brought about by developing the negative longer than Normal Development. Expansions are symbolized by N+, followed by the number of zones by which you want to increase the contrast. For example, N + 2 means to increase the negative's development time above Normal Development enough to raise a Zone VI negative density to a Zone VIII density.

Fall The term used to indicate the position of any subject's meter reading on the Zone Scale after another meter reading has been placed on a different zone. For example, when the contrast of the subject is Normal, the meter reading for the highlight will fall on Zone VII when the meter reading for the shadow is placed on Zone III.

Gamut The total range of colors that a digital device can reproduce.

Histogram A graphic representation of the range of tones or levels from dark to light in a digital photograph.

Important Highlight The area of the subject that you want to appear in the final print as a fully textured and detailed light gray tone. In most cases, this area will be previsualized as Zone VII. Light clothing, concrete, and fully textured white objects are typical Important Highlight Area subjects.

Important Shadow The area of the scene that you want to appear in the final print as a fully detailed dark value. This need not be an actual shadow. In most cases, the Important Shadow Area is previsualized as Zone III. Dark clothing, brown hair, and green foliage are common Important Shadow Area subjects.

Incident Light The light that falls on the subject from the light source; measured with an incident-light meter.

Indicating Arrow The arrow or pointer on a handheld light meter that is matched with the indicated meter reading to calculate the meter's recommended exposure. The meter number indicated by this arrow is automatically placed on Zone V.

Interpolation A mathematical method of creating missing image data to increase the file size and/or dimensions of an image.

Inverse Square Law A physical law stating that intensity of brightness radiating from a light source is inversely proportional to the square of the distance from the source; so an object (of the same size) twice as far away receives only one-quarter the illumination.

For photographers working in a lighting studio, this means that if you double the distance between a subject and light source, the illumination on the subject will be decreased by four times (two stops). Inversely, if you halve the distance between a subject and light source, the illumination will be increased by four times (again two stops).

JPEG A standard for compressing image data developed by the Joint Photographic Experts Group.

LCD (Liquid Crystal Display) A low-power monitor uses fluorescent lamps at the back of the screen. LCD Monitors are often used on the top and/or rear of a digital camera to display settings or the photo itself.

LED Monitors are the same as LCD monitors except that, instead of fluorescent lamps, Light Emitting Diodes (LED) at the back of the screen are used to provide illumination.

Levels In Photoshop these are a measure of image brightness that can be expanded or contracted with the Levels Command and are represented in the image's histogram.

Megabyte (MB) A measurement of data storage equal to 1,024 kilobytes (KB).

Megapixel Equal to one million pixels.

Neutral Gray Card A middle gray (18 percent) card designed for calibrating exposure meters and to serve as a visual reference for color reproduction. Also known as a "Zone V card."

Noise Random patterns of either color or brightness that appear in the shadow areas of digital images with higher ISO settings (400 and above).

Normal

1. **Subject Contrast** is said to be Normal when the meter readings of the Important Shadow and the Important Highlight fall on Zone III and Zone VII, respectively.
2. **Negative Contrast** is considered Normal when the negative prints well on a Normal grade of paper, usually paper grade 2 or multigrade-contrast filter 2.
3. **Normal Development** is the amount of development for a given film and developer that will produce contrast in the negative that is equal to the contrast of the subject. Normal Development is symbolized by N.

Pixel Pixels or picture elements are the smallest components of digital images. Digital camera and monitor pixels are the physical units that capture and display digital image data, respectively. Image pixels are the individual "tiles" of color or tone that make up the visible image on a monitor.

Placement The act of relating any single meter reading to a zone on the Zone Scale through controlled exposure. For example, to place a shadow reading on Zone III, you first meter that area with a reflected-light meter and then stop down two stops from the meter's recommended exposure.

Posterization See "Banding."

Previsualization (also "Visualization") The act of mentally picturing a photographic subject in terms of the finished print.

Profile A small data file that describes the color idiosyncrasies of each element of a color-managed digital workflow, including the monitor and printer, for the purpose of providing coordination of color rendition from one end of the process to the other.

Raster Image Processor (RIP) A raster image processor or "rip" is a highly integrated color management, page layout, and ink-handling system that provides high-quality results from inkjet printers.

Rasterization See "Bitmapped."

Raw Formats The unprocessed black-and-white data from a digital image sensor before it has been converted or Tone Mapped into a color format that can be edited with an application like Adobe's Camera Raw utility.

Reflected Light The light that is reflected from the scene to the camera and meter; measured with a reflected-light meter.

Resolution For analog photography, the term is used to describe a film's capability to record fine detail. For film, good resolution is a function of sharp focus, fine grain, good contrast, and minimum exposure and development.

For digital image files, good resolution is achieved through a combination of increasing the number of pixels per inch in your image and assigning an appropriately high bit depth to each pixel.

Tagging The process of attaching a profile to a digital image to allow it to be rendered accurately on other color-managed systems.

Textural Scale The range of five textured zones from Zone III to Zone VII.

Tonal Range The difference between the whitest white and the blackest black in a photographic print.

Tonal Separation See "Print Contrast" under "Contrast."

Tone The shades of gray, black, and white in a photographic print.

Tone Mapping The process of converting a digital image from its raw, linear state to a format that more closely resembles a familiar nonlinear distribution of tones.

Value The light and dark areas of a photographic subject, negative, or print.

Vector-Based Images A graphic image whose visual characteristics are created mathematically by an application like Adobe Illustrator. As opposed to a digital image composed of numerous individual picture elements or pixels.

Visualization See "Previsualization."

Zone The basic unit of photographic previsualization and contrast measurement.

1. Any one of 10 symbolic tones arranged in order from black to white. This 10-step scale is called the "Zone Scale." Each zone represents a small range of tones that can be found in both the final print and the original scene.
2. A unit of photographic measurement equivalent to all other photographic controls according to a ratio of 2 to 1.

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